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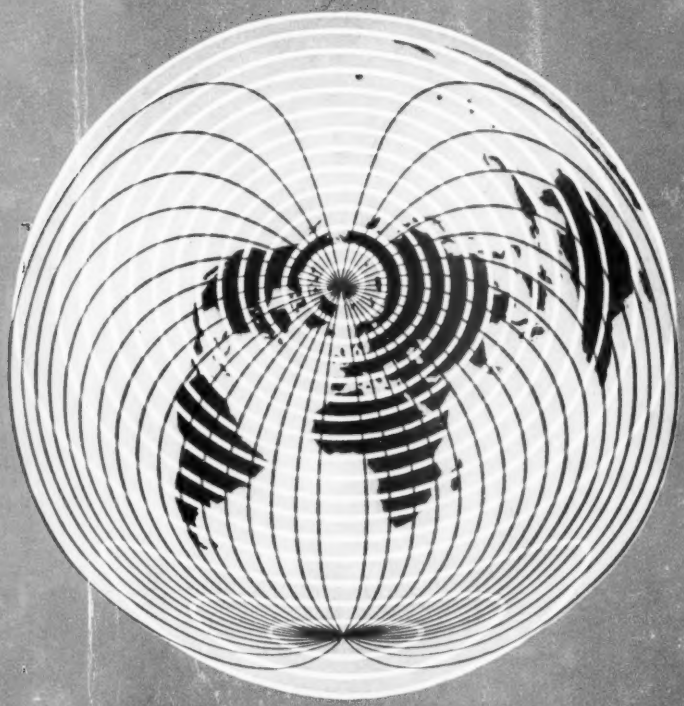
TWO SHILLINGS

Wireless World

ELECTRONICS

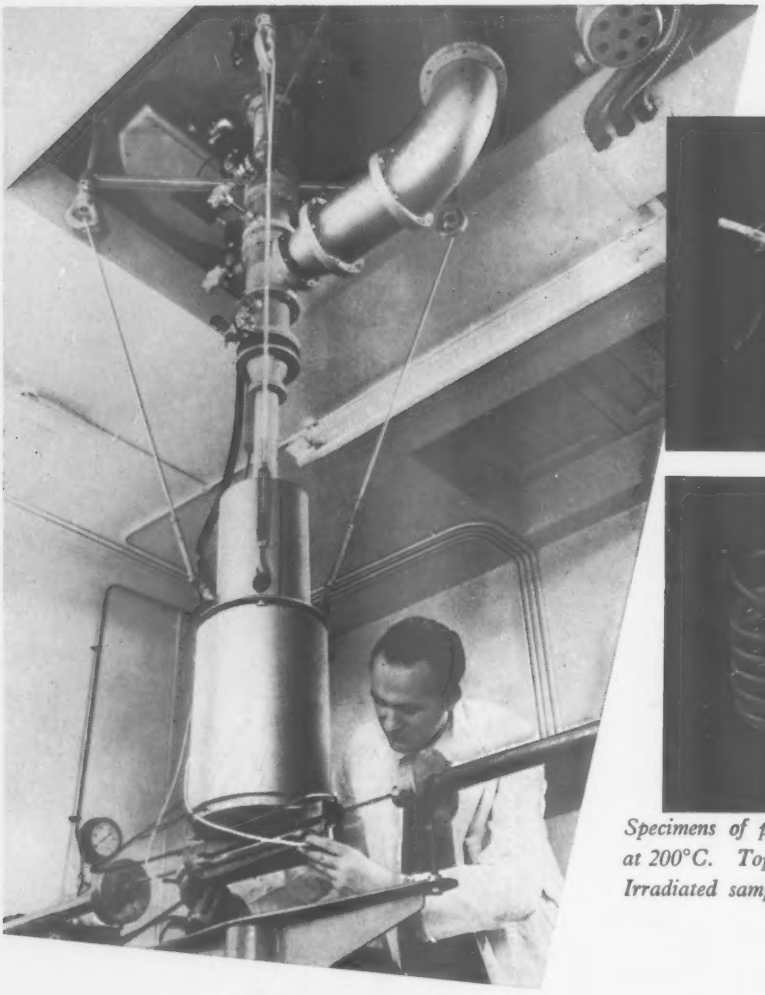
Radio · Television

MAY 1958

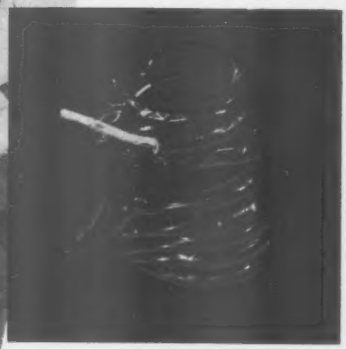


FORTY-EIGHTH YEAR OF PUBLICATION

XUM



Setting up polythene core ready for irradiation.



Specimens of polythene cable after heating at 200°C. Top: Normal sample. Bottom: Irradiated sample.

How we make good cables — better

Take polythene for instance, already noted for its excellent electrical characteristics and widely used in the cable industry.

Then make it stronger, more elastic and improve its temperature characteristics. The result, a better material still.

How do we do it? By bombarding polythene with electrons to cause a chemical change. A process known as electron irradiation and an important step forward in the general development of plastic materials for our wide range of cables.

We have a publication which tells you more about this process. May we send you a copy?

BICC IRRADIATION OF POLYTHENE

BRITISH INSULATED CALLENDER'S CABLES LIMITED
21 Bloomsbury Street · London, W.C.1

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MITED

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THE
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Pocket size... pocket wise!

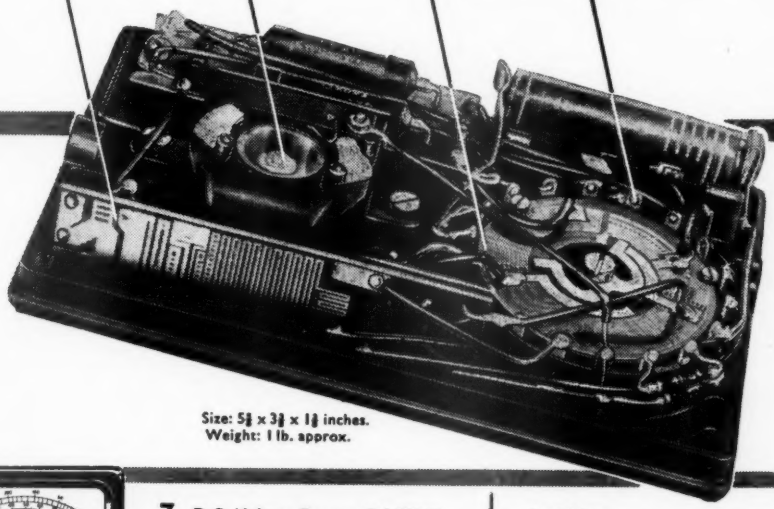
This sturdy multi-range test meter is remarkable for the wide range of test facilities which have been so neatly incorporated. Full advantage has been taken of printed resistor techniques to produce a compact instrument of low weight.

Printed resistance panel for universal meter shunt.

Composite printed resistors and auxiliary switch.

Meter movement is enclosed to give protection against the infiltration of dust.

Robust range switch similar to that used in the famous Avo-Meter. Eighteen fixed silver-plated contacts embedded in a ring of high-grade moulding material are swept by a double contact rotor arm.



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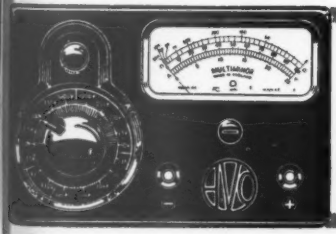
Regd. Trade Mark.

Size: 5¾ x 3¾ x 1¾ inches.
Weight: 1 lb. approx.



7 D.C. Voltage Ranges: 0-1,000 V.

5 A.C. Voltage Ranges: 0-1,000 V.

5 D.C. Current Ranges: 0-1A.

2 Resistance Ranges: 0-20,000Ω. 0-2MΩ.

Sensitivity:
10,000Ω/V on D.C. voltage ranges.
1,000Ω/V on A.C. voltage ranges.

Accuracy:
3% of full scale value on D.C.
4% of full scale value on A.C.

For a small additional charge, instruments can be supplied to a higher degree of accuracy.

THE MULTIMINOR

19 Ranges · Single Knob Control · List Price: £9:10s.

Complete with test leads and clips. Leather case if required 32/6.

● **Write for fully descriptive leaflet.**

AVO Ltd. AVOCET HOUSE · 92-96 VAUXHALL BRIDGE ROAD · LONDON · S.W.1.

VICtoria 3404 (9 lines)

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SOLARTRON

'packaged' power

sub-units

It's so easy to put in a ready-made, self-contained, completely reliable Power Supply sub-unit!

these are design centre performance figures

	SRS 156	AS 516	AS 517	AS 616	AS 619	AS 754	AS 755
VOLTAGE	±150V	±250V or ±300V	±250V or ±300V	±250V or ±300V	±150V to ±180V	±250V or ±300V	±250V or ±300V
CURRENT	0-40mA	0-50mA	10-100mA	0-1A	0-200mA	0-200mA	0-500mA
A.C. OUTPUTS	6.3V 4A C.T 6.3V 1A	6.3V 4A C.T. 6.3V 1A	6.3V 4A C.T. 6.3V 2A C.T. 6.3V 1A	6.3V 10A C.T.	6.3V 4A C.T. 6.3V 4A C.T. 6.3V 1A C.T.	6.3V 6A C.T. 6.3V 6A C.T. 6·3V 2A	6.3V 10A C.T. 6.3V 5A C.T.
D.C SOURCE IMPEDANCE	<2Ω	0·3Ω	0·2Ω	0·4Ω	0·5Ω	0·4Ω	0·05Ω
STABILISATION FACTOR	400:1	1000:1	800:1	500:1	400:1	500:1	500:1
A.C. SOURCE IMPEDANCE 40c/s—100kc/s	<2Ω	0·1Ω	0·15Ω	0·2Ω	0·2Ω	0·4Ω	0·2Ω
RIPPLE AND NOISE CONTENT	<350μV	100μV	150μV	300μV	100μV	150μV	300μV
DIMENSIONS	9½" × 6½" × 6½" high	9½" × 6½" × 6½" high	9½" × 7½" × 6½" high	19" × 19" × 10½" high	10" × 10" × 6 7/16" high	13" × 6½" × 6½" high	19" × 12" × 8¾" high
WEIGHT	14½ lbs	14½ lbs	20½ lbs	150 lbs	21½ lbs	25 lbs	56 lbs

* Better stability factors
* More heater power
* Less ripple and noise
* No increase in cost for this improved performance
* Lower source impedance
* Stability unaffected by capacity loading
* Delivery ex-stock

SOLARTRON **Power Supply Sub-units**

THE SOLARTRON ELECTRONIC GROUP LTD • THAMES DITTON • SURREY • ENGLAND

Telephone: EMBerbrook 5522 · Cables: Solartron, Thames Ditton

a new valve for 470 Mc/s equipment

— unique double tetrode range extended

QQVO2-6

Here is a new six watt double tetrode for low cost 470Mc/s mobile equipment. This compact valve features a frame grid and the same unique twin construction as other Mullard double tetrodes—a construction which provides high efficiencies, high power gain and heater economy.

Other features of the QQVO2-6 include built-in neutralising capacitors which enable circuitry to be simplified, and low inter-electrode capacitances which allow wide tuning ranges to be achieved and which contribute to high efficiency.

Write to the address below for full details of the QQVO2-6 and other Mullard double tetrodes.

BASE	B9A
CATHODE	Indirectly heated
HEATER (Centre tapped)	
Series	12.6V, 0.3A
Parallel	6.3V, 0.6A

CAPACITANCES

*ca–g′ (each section)	less than 0.16pF
cg′–all (each section)	6.4 pF
ca–all (each section)	1.6 pF
cout (two sections in push-pull)	0.95 pF
cin (two sections in push-pull)	3.8 pF

* Internally neutralised for push-pull operation.

CHARACTERISTICS

(each section) measured at Ia = 25mA, Va = Vg″ = 150V.

gm	10.5mA/V
μg′–g″	31

TYPICAL OPERATING CONDITIONS

	Telegraphy or F.M.	Telephony—A.M.	
f	470	470	Mc/s
Va	180	180	V
Vg2	180	180	V
Ia	2 x 27.5	2 x 20	mA
pa	2 x 2.1	2 x 1.5	W
Pout	5.8	4.2	W
Pload	4.5	3.4	W

THE MULLARD DOUBLE TETRODE RANGE

. . . . the most comprehensive and efficient in the world

	Typical F.M., Power Output
QQVO2–6	5.8 watts
QQVO3–10/6360 (CV2798)	11 watts
QQVO3–20A/6252 (CV2799)	25 watts
QQVO6–40A/5894 (CV2797)	56 watts

Mullard

COMMUNICATIONS AND INDUSTRIAL VALVE DEPARTMENT

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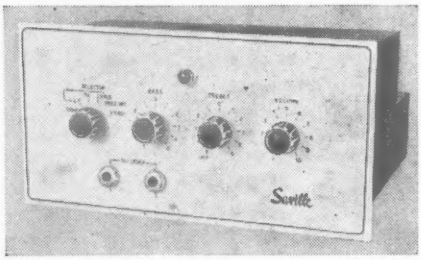
TORRINGTON PLACE · W.C.1 · Tel: LANgham 6633

MVT. 343a

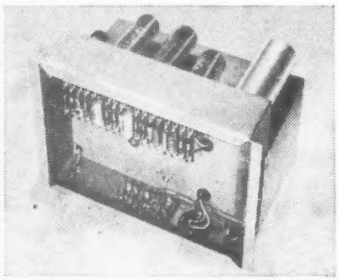
This is the amplifier that will not date

'Saville' is the amplifier of the future. It has been designed in the light of the very latest developments for the reproduction of sound in the home, including the revolutionary new stereo discs—3-dimensional sound. Produced by the makers of ***Period High Fidelity,*** *'Saville' inherits all the technical excellence and superlative craftsmanship for which the company is renowned. 'Saville' offers the high fidelity enthusiast a top-quality amplifier with provision for twin-channel tape and disc reproduction plus the ultimate in new recording techniques.*



SAVILLE PRE-AMPLIFIER

Construction and wiring are to the highest instrument standards and all components are very conservatively rated. **PRICE £15.0.0**



SAVILLE MAIN AMPLIFIER

Output transformer is of the distributed load "C" core type, and there is ample H.T. and L.T. for auxiliary equipment. **PRICE £27.0.0.**

ADVANCE FEATURES

PRE-AMPLIFIER

- ★ 6-position control: radio, tape (direct from deck), gram 78, gram L.P, stereo records, stereo tape.
- ★ Equalisation: tape to C.C.I.R. characteristics; gram to R.I.A.A. characteristics; stereo position fully equalised.
- ★ Treble cut and boost:— 20 db to +14 db.
- ★ Bass cut and boost:— 20 db to +20 db.
- ★ Inputs at rear of chassis: radio, tape, gram, stereo tape, stereo gram.
- ★ On front panel, sockets for monaural tape recorder and Ferrograph 77 and 88 stereo recorder.
- ★ Two entirely separate channels are provided, matched to within 1 db, all the controls being matched and ganged on the two channels.

MAINS AMPLIFIER

- ★ Output: 20 watts rated. 30-35 watts peak.
- ★ Power response: at 20 watts — 32 c/s to 30,000 c/s ±1 db
- ★ Distortion measured at 1,000 c/s and 20 watts: <0.1%
- ★ Hum and noise: 85 db down at rated output.

Post this coupon today to

PERIOD HIGH FIDELITY Ltd.,
28 SOUTH ST., MAYFAIR, LONDON, W.1
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for full details of the 'Saville' amplifier.

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LIMITED
28 SOUTH STREET MAYFAIR, W.1. Tel.: GRO 4686

MUTUAL & SELF INDUCTANCE BRIDGE

Designed for the accurate measurement of either mutual or self inductance and resistance in the range 0·001μH to 30mH and 100μΩ to 3000Ω respectively.

All measurements are made in the form of a four-terminal network and inductance and resistance of leads and clips are not included in the measurement.

Accuracy within ± 1% frequency 1592c/s (ω = 10 000)

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The Connectors and Rotary Transformers produced for many years by our Associate Company, Power Controls Limited, will in future be manufactured and marketed by ourselves. This, from our customers point of view is simply a change in name.

Improved cable clamps on the new range of our Miniature Hermetically Sealed Co-axial Plugs and Sockets will withstand a pull of up to 35 lbs., and are suitable for use with Uniradio 70 cable.

They have been developed and Type Approved to Inter-Service Requirement under R.C.S. 322 and are freely interchangeable with the types which they supersede.

The new types are hermetically sealed and 100% production tested. Sealing caps are available for uncoupled units.

MAGNETIC DEVICES LIMITED

MAGNETIC DEVICES LIMITED

A. I. D. & A. R. B.—Approved

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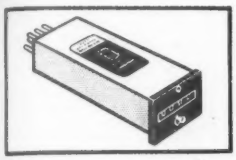
MD 23A

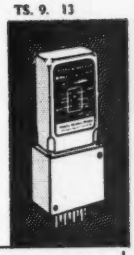
TS. 10. 11



TS. 8

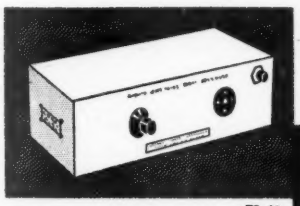
TS. 1. 4. 7. 14 16. 18. 19

TS. 9. 13



TRANSISTORIZED PLUG-IN STAGES

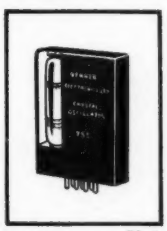
TS. 2A. 2B



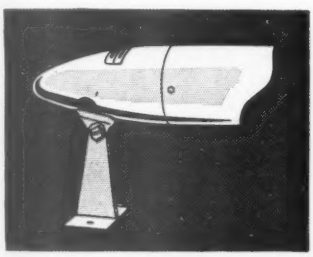
TS. 20

TS. 3. 6. 17

FOR HIGH-SPEED COUNTING



TS. 5



TS 12

Illustrated above is the Venner range of transistorized plug-in stages shown approximately ¼ of their actual size. Write for Brochure WW/104.

THE Venner range of transistorized plug-in stages has a potential life far greater than any valve operated stage. Components are subjected to little stress due to the low potentials associated with the transistor, and the correspondingly low power consumption. One nominal 10V supply is common to the range, as are the input and output connexions. Input leads have isolating condensers in series, output connexions are direct.

VENNER

ELECTRONICS LTD.

Kingston By-Pass, New Malden, Surrey.
Telephone: MALden 2442 (9 lines)

(A member of the Venner Group of Companies)

TABLE OF VENNER TRANSISTORIZED STAGES

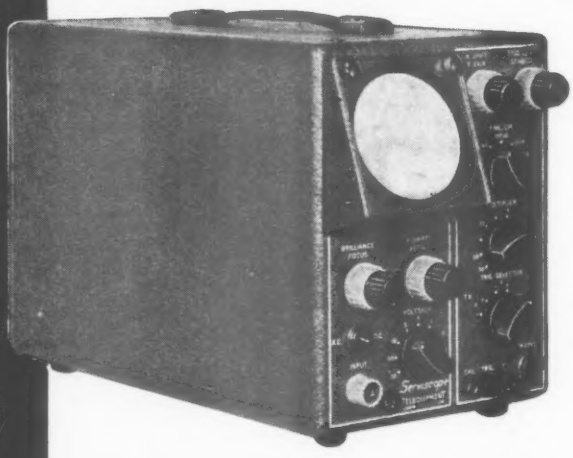
Ref.	Name of Stage	Function of Stage	To Drive
TS1	1000 c/s Oscillator	Stable frequency source of ±1% tolerance. Sine wave and squarewave output.	TS3, 4, 6, 7, 14, 16, 17.
TS2A TS2B	Binary Unit	Provides one output pulse for two input pulses at PRF's up to 30 K.p.p.s.	TS2, 7 to 11, 13, 14, 16, 17, 18.
TS3	Wide Band Amplifier	Amplifies input voltage by a factor of approx. 1000 over a frequency range of 15 c/s to 125 kc/s.	TS2, 3, 4, 7, 8, 10, 11, 13, 14, 16, 17.
TS4	2-Stage Amplifier	Amplifies input voltage by a factor of 1000 over a frequency range of 120 c/s to 10 kc/s.	TS2, 4, 7, 8, 10, 11, 13, 14, 16, 17.
TS5	10 kc/s Crystal Osc.	Ultra-stable frequency source with an accuracy of 3 parts/million. Sine and squarewave outputs.	TS2, 3, 6, 7, 10, 11, 14, 15, 16, 17.
TS6	Selector Gate	Schmitt trigger circuit. Basically intended for use with TS11.	TS2, 6, 8, 9, 10, 11, 13, 16, 17, 18.
TS7	Shaping Amplifier	Converts input waveforms into pulses suitable for triggering the Binary and Decade stages.	TS2, 8, 10, 11, 13, 16, 18.
TS8	Cyclo Counter	Transistorized Electro-mechanical Counter which ensures correct operation irrespective of duration of input pulse.	May be used to reset TS2, 10, 11.
TS9	D.C. Relay Stage	Permits 5A, 250V changeover contacts to be operated from a 100 MicroA source.	May be used to reset TS2, 10, 11.
TS10/5	Decade Counter	Divide-by-ten or Divide-by-five stage divides and counts inputs up to 30 K.p.p.s.	TS2, 8 to 11, 13, 16 to 18.
TS11	Decade Selector	Used in conjunction with 10 position switch and TS6 unit permits selection of any pulse 0-9.	TS2, 6, 8, 9, 10, 11, 13, 16, 17, 18.
TS12	Photohead	Sensitive photo-transistorized head for universal use. Direct coupled, anti-phase outputs.	TS3, 4, 6, 7, 8, 9, 13, 14, 16, 17, 18.
TS13	Triggered Relay Stage	Ensures 0.05 second operation of 5A 250V changeover contacts when pulsed.	May be used to reset TS2, 10, 11.
TS14	Pulse Shaper	Provides constant amplitude antiphase pulses for all inputs. Ideal for triggering binary and decade stages.	TS2, 8, 10, 11, 13, 16, 18.
TS16	Universal Gate	Unity gain stage which can be switched ON and OFF by D.C. level change as provided, for example, by TS2B.	TS2, 3, 4, 8, 10, 11, 13, 15, 17, 18.
TS17	Twin Emitter Follower	Two separate high input impedance stages with low output impedances. Equivalent to cathode follower.	TS2, 3, 4, 6, 7 to 11, 13 to 18.
TS18	Period Timer	Provides D.C. voltage change for externally adjustable period. (Fixed internal period is 10 secs.).	TS2, 6, 8 to 11, 13, 16, 18.
TS20	Stabilized Power Supply	Provides 8-12V D.C. (adjustable) at 300mA when fed from 200/250V 50 c/s mains.	All stages.

THE SERVISCOPE

REGD TRADE MARK

DC TO 6 Mc/s

TIME AND VOLTAGE CALIBRATION



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★ INCORPORATES AN ENTIRELY NEW TYPE OF TIME BASE
formerly only available on the most expensive American oscilloscopes.

★ 18 PRE-SET CALIBRATED SWEEP SPEEDS FROM
.5 sec/cm to 1 μ sec/cm

★ AUTOMATIC TRIGGERING OR TRIGGER LEVEL SELECTION

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★ 9 CALIBRATED Y SENSITIVITIES
FROM 100 mV/cm to 50V/cm ALL DC TO 6 Mc/s

★ SWEEP EXPANSION TO OVER 10 SCREEN DIAMETERS

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THE FINEST, MOST VERSATILE

portable oscilloscope ever offered to the electronics industry.

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The controls of the Eddystone "680X" receiver are laid out so conveniently that the Professional operator quickly "takes" to the receiver and is able to make the most of its extremely good performance. All normal communications facilities are provided :— variable pitch BFO; crystal filter; wide range of selectivity; noise limiter; 600 ohm balanced output. There are two RF and two IF stages, all valves being of Service-approved types. Frequency coverage is continuous from 480 kc/s to 30 Mc/s. Available in table and rack-mounting versions. Robust all-metal construction and suitable for use in any climate. The illustrated brochure gives full particulars and you are cordially invited to write for it.

The **EDDYSTONE**

MODEL 680X

COMMUNICATIONS RECEIVER

RADIO PRODUCTS EDDYSTONE TRADE MARK

Manufactured by **STRATTON & CO LTD** *Birmingham, 31.*

For the best of reasons

★ **Perfect reproduction**

★ **Ease and simplicity of operation**

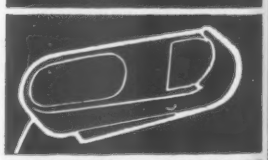
★ **"Know-how" in manufacture**

buy TRUVOX—and you buy all three. The Truvox R2 Recorder, with its improved circuitry and styling, embodies all the experience of 7 years specializing in the design, development and manufacture of Tape Decks and Tape Recording Amplifiers. There are no last minute "mods"—every stage has been tested and tested again to ensure that it lives up to the reputation enjoyed by the name it bears.

The result is a high fidelity instrument that will give you endless hours of enjoyment producing and replaying your own recordings as well as providing perfect reproduction of pre-recorded tapes with all those finer gradations of tone that are there for those who can hear the difference.

Additional applications of this machine, with accessories, include dictation and transcription, radio reception, telephone conversation recording, AM or FM Tuner amplification, etc.

When you buy TRUVOX you buy a better recorder—produced *for those who can hear the difference.*



Models from **66gns**

TRUVOX ***Tape Recorders***

Full details, including accessories, available on request from the manufacturers :

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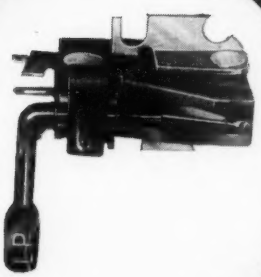
INTRODUCING THE SONOTONE 2T

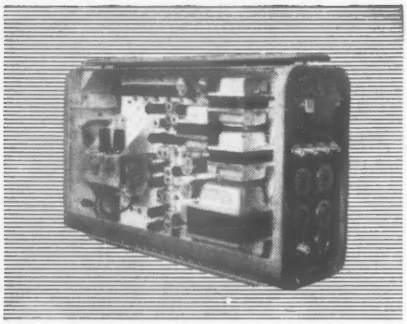


All the recorded sound — that's the way the 'Sonotone' 2T equipped radiogramophone will play it! The revolutionary Sonotone pick-up head — a superior, highly sensitive product — represents another step forward in modern sound head technique by T.C.L. It is completely humidity and temperature proof, produces no magnetic hum and has a great many other technical advantages which are discussed fully in T.C.L. publication No. 1106. Design Engineers are invited to ask for a copy and for any further technical information they may require.

TCL

Technical Ceramics Limited, Wood Burcote Way, Towcester, Northants
Telephone Towcester 312

TCL.1



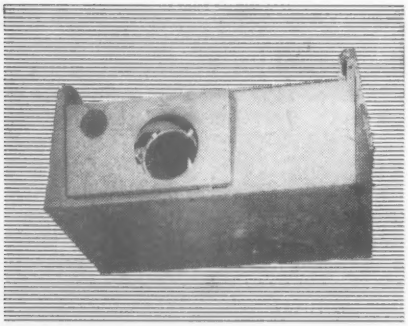
Mobile sound and vision receiver designed and produced by P.A.M. LTD. for Marconi's Wireless Telegraph Company Limited. It is primarily intended for use in studio and mobile control rooms.

If it's Electronic . . .

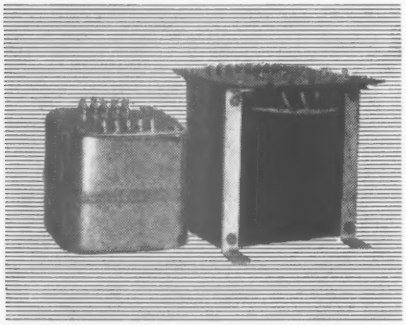
and you want it Designed and Developed or produced to your specification*

Consult

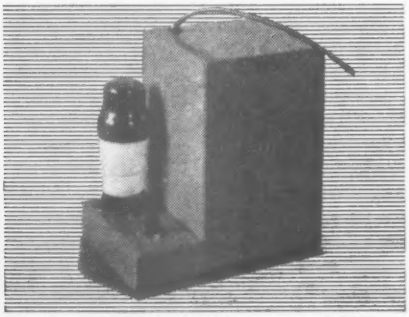
P.A.M.LTD



Model P.48 Ceiling Projection Receiver for closed circuit Television for Industrial use giving a picture up to 4ft. x 3ft.



Open and Shrouded types of Transformers for general use in electronic equipment. Designed and manufactured to individual requirements.



R.F., E.H.T. Unit. A safe, D.C. high voltage unit specially designed to meet the need for a reliable source of supply for Television C.R. Tubes. Also satisfactory for flash testing where a D.C. supply is necessary.

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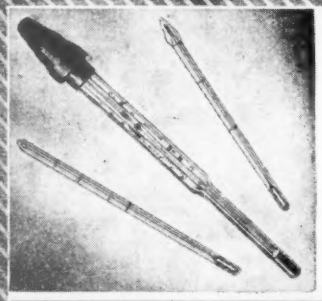

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Comparison
(−30% to+45%)

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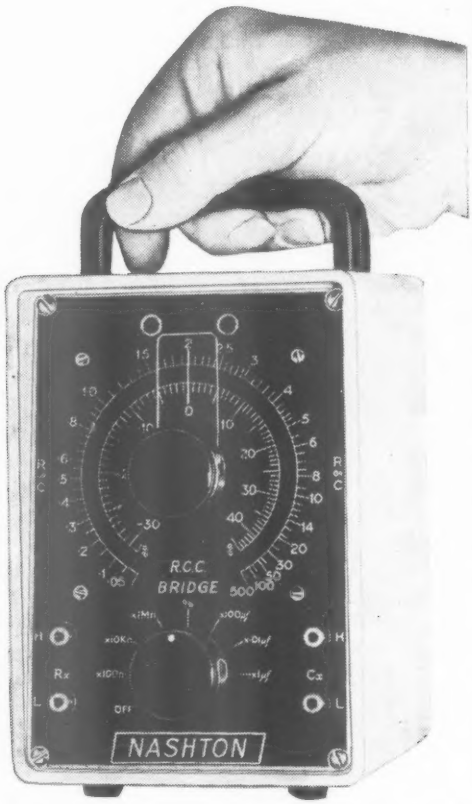

The Nashton R.C.C. Bridge is the first of a new range of electrical test instruments by Nash & Thompson, the Company specially selected to carry out the R.C.S.C. approval testing for the Ministry of Supply. The R.C.C. Bridge is precision-built of high stability 1% components and incorporates a 0.1% linearity wire-wound cam-corrected balancing potentiometer.

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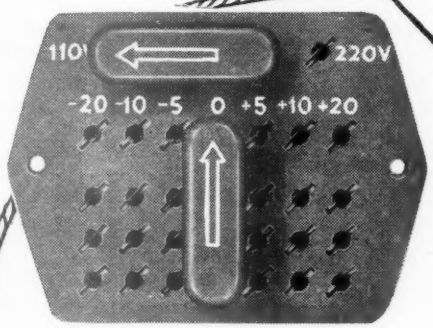

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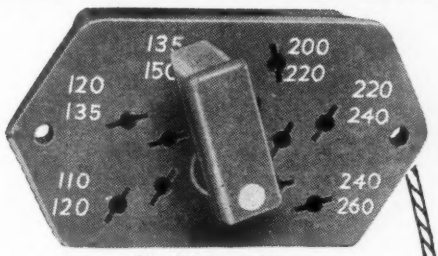
NYLON LOADED P.F. MOULDING



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Type BVS/4
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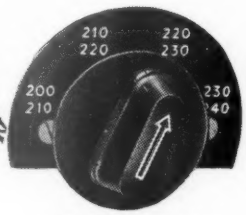

3 Pin Shorting Plug

6 WAY MINIATURE
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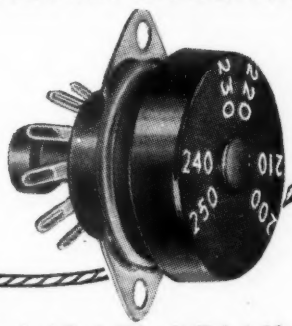
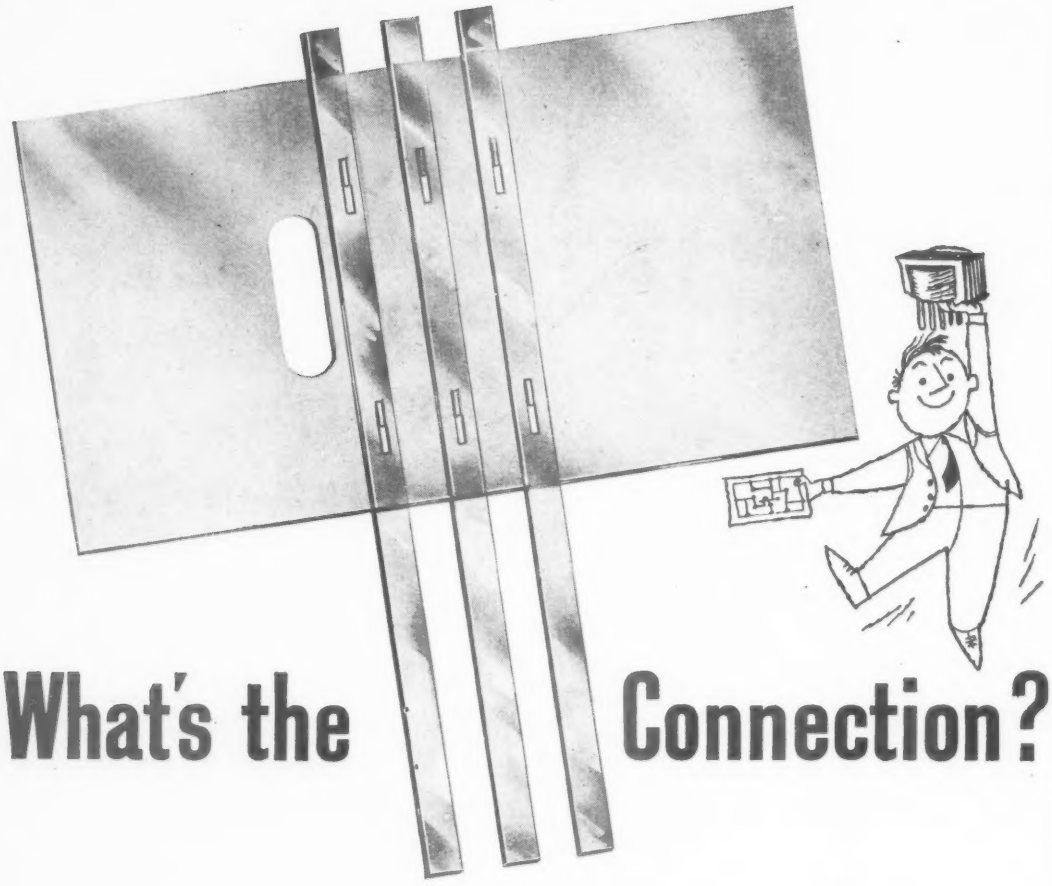


Standard B9A (Noval) Valveholder with 2 Pin Captive Shorting Plug

Send for full details to :—

THE McMURDO INSTRUMENT CO. LTD., ASHTEAD, SURREY. Tel: ASHTEAD 3401

MVS15



What's the Connection?

It's a very neat one—a special tri-acetate harness assembly of high electrical quality which allows assembly shops to connect Hinchley transformers to the now widely used printed circuits with an absolute minimum of labour. It was made on a special purpose machine designed by Hinchley when printed circuits first came to Britain. It is this kind of foresight, coupled with specialized production techniques, rigid quality control, an unequalled design service, and—vital today—cost consciousness, that has kept Hinchley in the forefront of the industry. Our technical service is immediately at your call. Why not make use of it?

Take a look at the quality of

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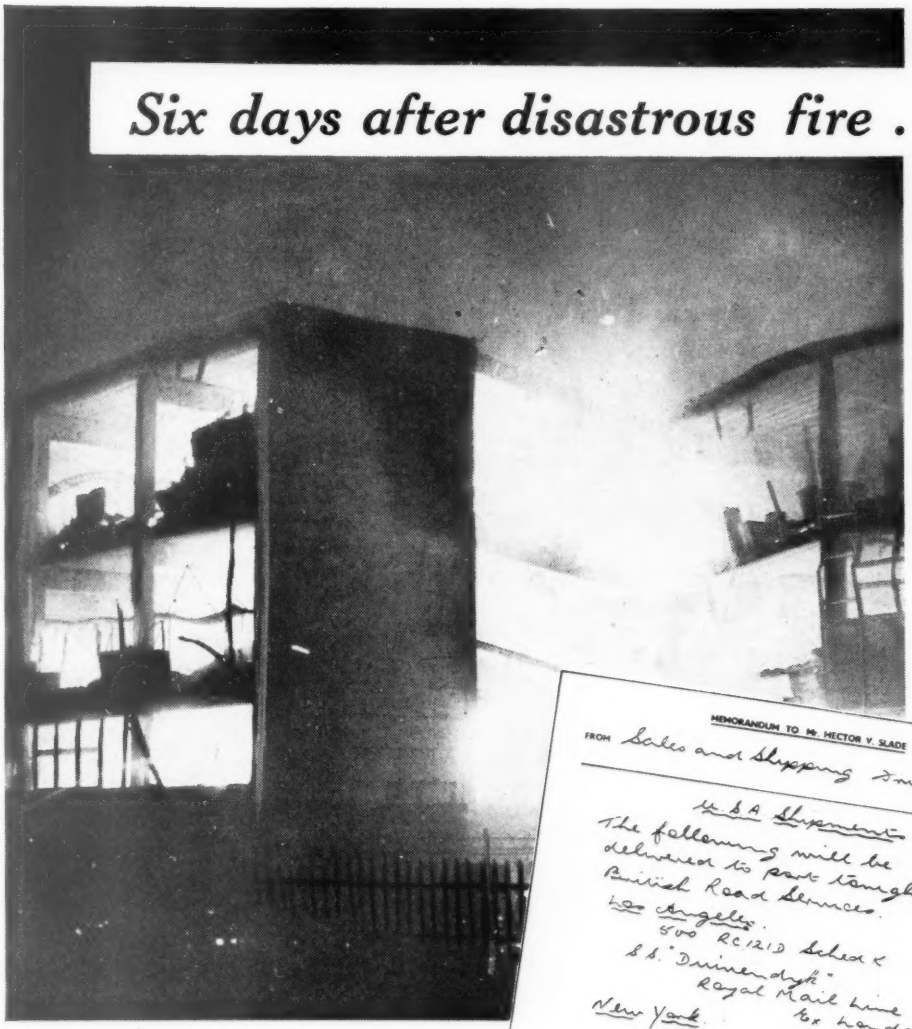
Six days after disastrous fire . . .



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MEMORANDUM TO Mr. HECTOR V. SLADE

FROM Sales and Shipping Monday 25 March

U.S.A. Shipment

The following will be delivered to Park tonight by British Road Services.

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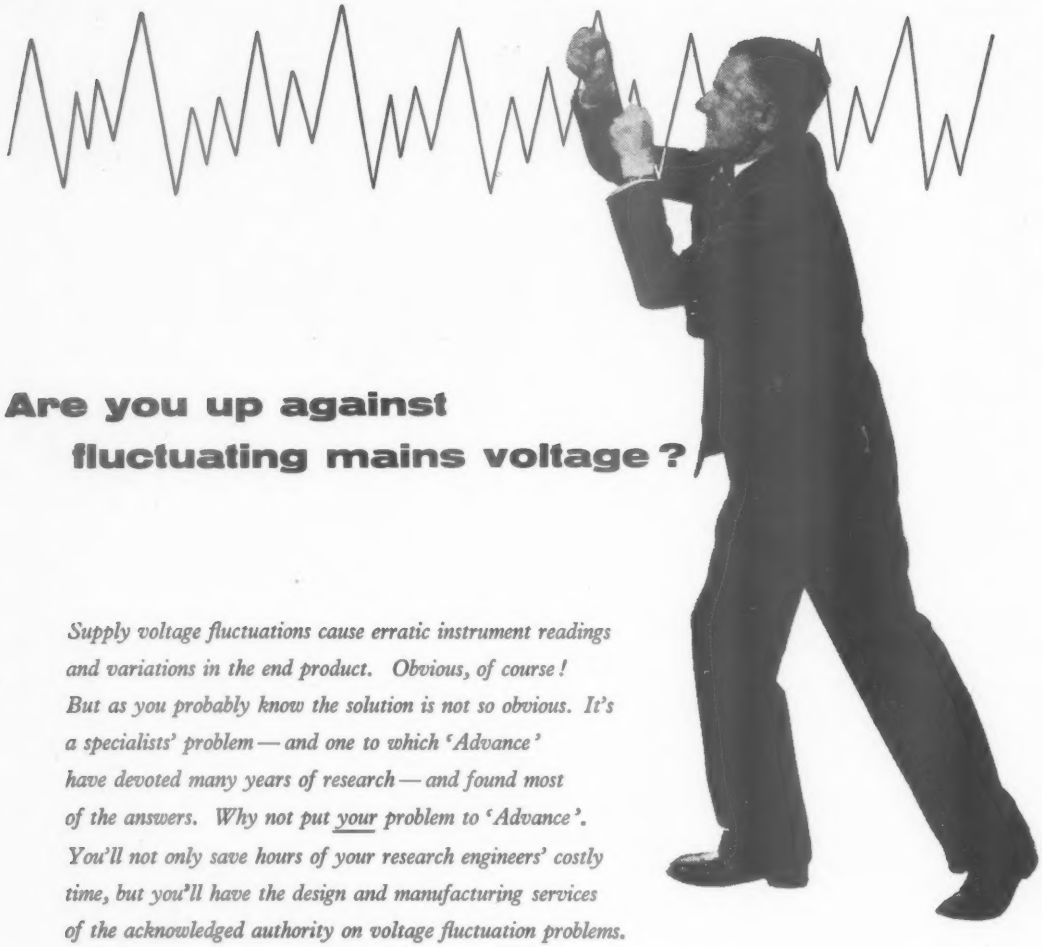

Are you up against fluctuating mains voltage?

Supply voltage fluctuations cause erratic instrument readings and variations in the end product. Obvious, of course! But as you probably know the solution is not so obvious. It's a specialists' problem — and one to which 'Advance' have devoted many years of research — and found most of the answers. Why not put your problem to 'Advance'. You'll not only save hours of your research engineers' costly time, but you'll have the design and manufacturing services of the acknowledged authority on voltage fluctuation problems.

Advance can help you

Full technical details available in Leaflet W.54.

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A HIGH FIDELITY 30 WATT AMPLIFIER INCORPORATING PRE-AMPLIFIER AND TONE CONTROLS

EMPLOYING THE LATEST MULLARD EL34 OUTPUT VALVES IN ULTRA LINEAR OPERATION AND HIGH GRADE SECTIONALIZED OUTPUT TRANSFORMER.

Size approx. 13 x 8½ x 7in. Stoved gold hammered finish Weight 14lb. For operation on 200-250 v. 50 c.p.s. A.C. mains. Or other voltages to order. A chrome-handled cover is available at **19/6.**

15 Retail Price GNS.

The Following Outstanding Test Figures Include Pre-amplifier and Tone Control Stages

FREQUENCY RESPONSE.
(Exc. Rumble Filter.) ±1 d.b. 20-20,000 c.p.s.

RUMBLE FILTER.
12 d b. per octave below 50 c.p.s.

BASS CONTROL.
Continuously variable +12 d.b. to −12 d.b. at 50 c.p.s.

TREBLE CONTROL.
Continuously variable. +12 d.b. to −6 d.b. at 12,000 c.p.s.

HUM LEVEL.
Referred to full output −73 d.b.

MAXIMUM POWER OUTPUT.
In excess of 33 watts.

MAINS POWER CONSUMPTION.
110 watts.

STABILITY.
Entirely stable with capacity of .08 mfd. in parallel with loudspeaker load.

EFFECTIVE OUTPUT IMPEDANCE.
0.9 ohms across 15 ohm terminals.

INPUT IMPEDANCE.
Both inputs 500k plus 10 pfd

NEGATIVE FEEDBACK.
Total 28 d.b.

SENSITIVITY.
Input (1) 20 millivolts for rated output.
Input (2) 200 millivolts for rated output.

HARMONIC DISTORTION.
0.05% at 10 watts. 0.1% at 20 watts.

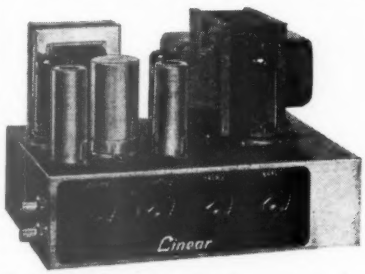
OUTPUT SOCKETS.
Provide matchings for 3 ohm and 15 ohm loudspeakers.

EXTERNAL POWER SUPPLY.
300 v. 30 m/a. 6.3 v. 1.5 a. for radio tuner.

VALVES.
B.V.A. EF86 EF86, ECC83, EL34, EL34, GZ34.
Due to use of Mullard EF86 valves microphony is virtually nil.
As in our extremely successful 'Diatonic' two individually controlled inputs provide mixing facilities for microphone and gram., etc., etc.

The 'DIATONIC' HIGH FIDELITY 10-14 WATT ULTRA-LINEAR AMPLIFIER

WITH INTEGRAL PRE-AMP AND TONE CONTROLS



Size only 9-7-6½in. Weight 12½lb. Power consumption 120 watts. Outputs for 3 and 15 ohm loudspeaker.

12 Retail Price GNS. For A.C. mains 200-250 v. 50 c.p.s. Or other voltages to order. Chassis finish stoved hammered gold, or grey blue.

Attractive cover with chromium carrying handles now available at **17/6.**
Full advantage has been taken of the latest component miniaturization developments to reduce unit size to a minimum.
Two high impedance input sockets are provided for microphone and gram., etc. Each input has its associated vol. control.
B.V.A. valves are employed, ECC83, ECC83, EL84, EL84, EZ81.

ALL TEST FIGURES INCLUDE PRE-AMP FREQUENCY RESPONSE.
±2 d.b. 30-20,000 c.p.s

MAXIMUM POWER OUTPUT
In excess of 14 watts.

RATED OUTPUT 10 WATTS.

SENSITIVITY.
Vol. (1) 22 millivolts for rated output.
Vol (2) 220 millivolts for rated output.

TREBLE LIFT CONTROL.
Continuously variable +6 d.b. to −13 d.b. at 12,000 c.p.s.

BASS CONTROL.
Continuously variable +13 d.b. to −18 d.b. at 50 c.p.s.

HARMONIC DISTORTION.
0.19% measured at 6 watts

HUM LEVEL.
Referred to maximum output −60 d b.

NEGATIVE FEEDBACK.
Total 32 d.b.

H.T. and L.T. Supply Point is included for a radio tuner.

ALSO AVAILABLE:

The L45. A compact High Quality 4-5 watt amplifier.

Size approx. 6-5-5¾in. high. Sensitivity is 28 millivolts so that the input socket can be used for either microphone or gram., tape, radio tuner, etc. B.V.A. valves used are ECC83, EL84, EZ90. Controls are: Vol., Treble and Bass with mains switch. The Tone controls provide full compensation for long playing records. Output matching for 3 ohm loudspeaker.

Retail price **£5/19/6.**

THE LT45 TAPE DECK AMPLIFIER. A complete unit (power pack and oscillator incorporated) ready for connection to A.C. mains. 3 ohm loudspeaker and practically any make of deck. Negative feedback equalization adjustment by multi-position switch for 3¾, 7½ and 15in. per sec.

Retail price **12 gns.**

THE LG3 GRAM AMPLIFIER. Overall size 6¼ × 4½ x12½in. Controls: Vol. and Tone (with mains switch). Output for 2-3 ohm loudspeaker. All above for 200-250 v. 50 c.p.s. A.C mains

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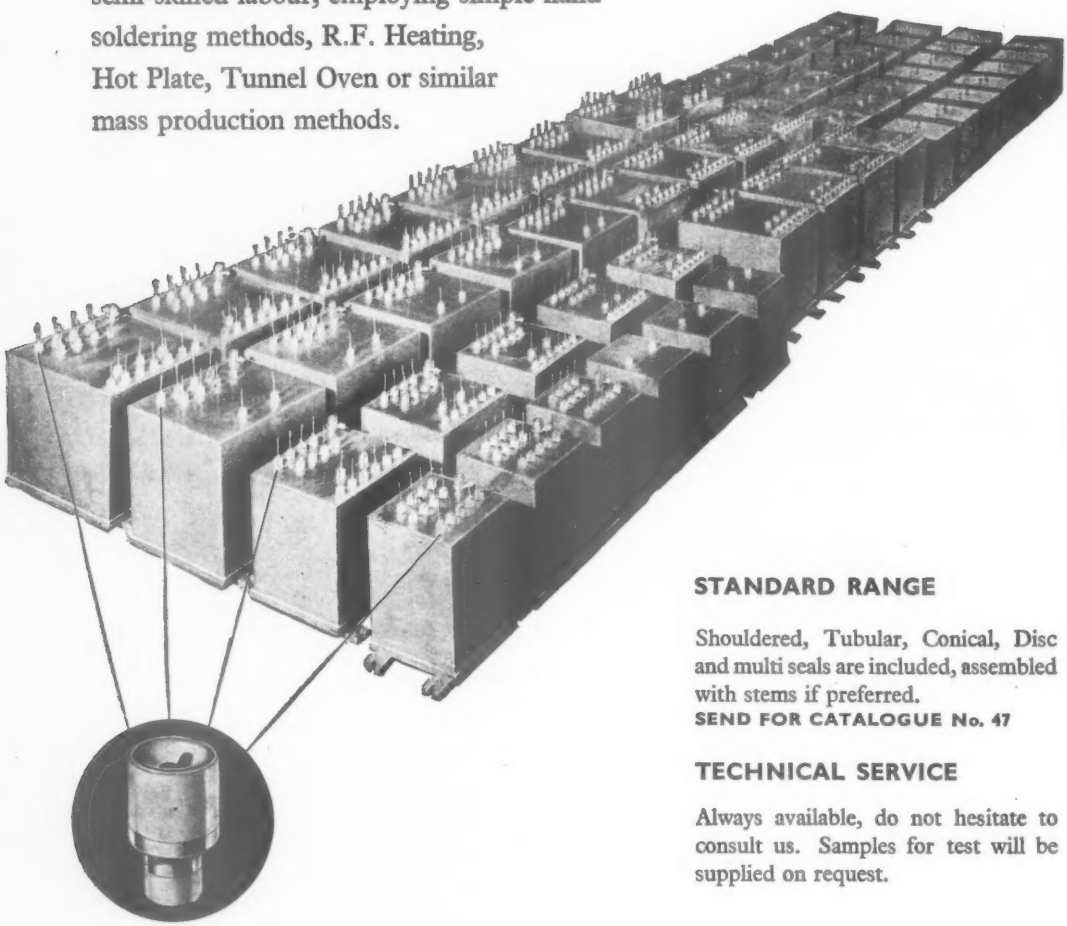

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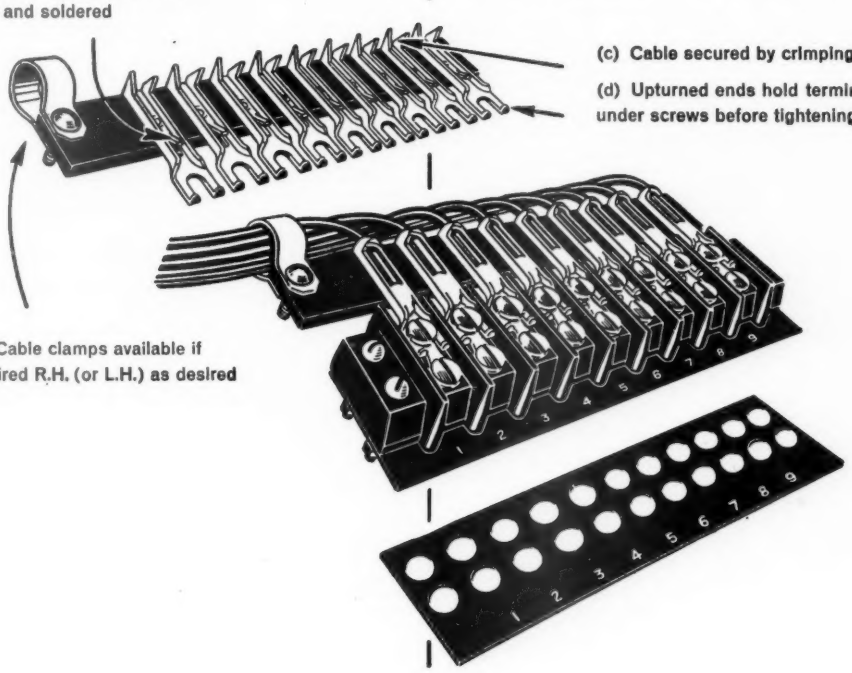
(d) Upturned ends hold terminal under screws before tightening



(b) Cable clamps available if required R.H. (or L.H.) as desired

'Standard' series are available with various types of terminals, up to 21 way– 'Miniature' series up to 12 way. Insulating materials phenolic or 'Mikacin' as specified.

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This new High Fidelity Speaker, incorporating a very powerful magnet assembly, is noteworthy for its brilliant transient response when mounted in a bass reflex cabinet. The H.F.1016 is designed for use as a single unit for high fidelity reproduction, but may also be used in conjunction with the Stentorian T.10 Tweeter Unit as an outstanding two-speaker system at remarkably low cost. Write for leaflets on other W.B. products. **£8** *(inc. P.T.)*

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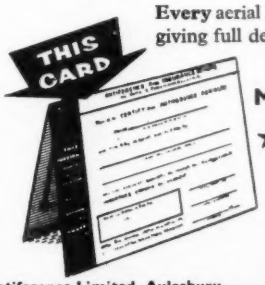

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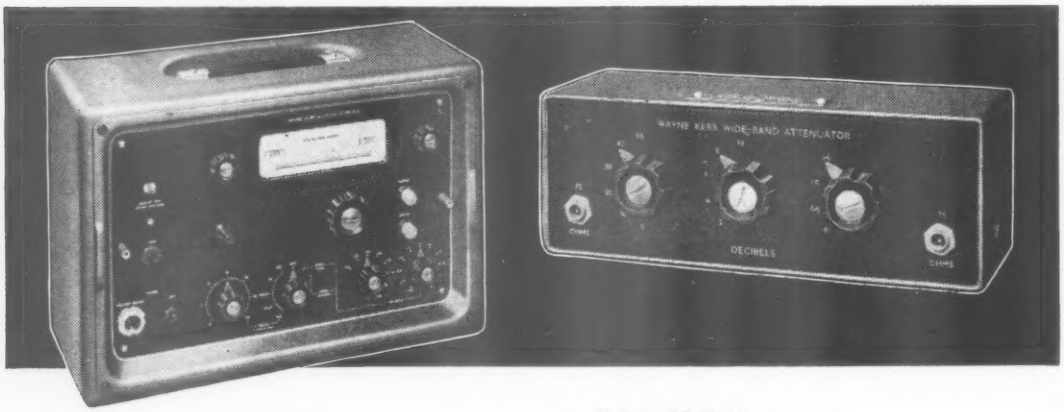
WIDE BAND ATTENUATOR Q.251



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- High Stability
- Low Distortion

- D.C. to 60 Mc/s
- 0—60dB in 0·5dB steps
- 75Ω Characteristic Impedance
- Accuracy D.C. to 20Mc/s 0·1dB, 60Mc/s 0·3dB

The S.121 is a high grade instrument providing a stable signal of very low harmonic content within the frequency range 10c/s—120kc/s.

The dial display is designed for simple and rapid operation and permits either the selection of major intervals by means of switches, or the continuous fine control of frequency on an open horizontal scale.

Two alternative outputs are provided. A step attenuator covers +10dB—70dB in 1dB steps on a reference level of 1 milliwatt into 600 ohms. The second output provides a continuously variable voltage from 0—30V in five decade ranges. The stability of the output level is ±0·2dB over the whole frequency range. Despite its high performance the instrument is compact, light and portable.

A light, compact, variable attenuator for use in the frequency range 0—60Mc/s. The instrument, which has a high performance, is rigidly constructed and is suitable for bench use or as a unit for incorporation in laboratory and test equipment. **PRICE £30**

SPECIFICATION OF AUDIO OSCILLATOR S121

MAINS INPUT
110/120V or 200/250V, 50/60c/s.

FREQUENCY
Range: 10c/s to 120kc/s.
Accuracy: ±1%±0·5c/s.

OUTPUT
1. 600Ω unterminated
2. 600Ω terminated
3. 0 to 30V variable impedance source.

OUTPUT LEVEL
Stability: 600Ω output±0.2dB

WAVEFORM DISTORTION
300c/s to 20kc/s <0.2%,
10c/s <2·5%, 100kc/s <0.4%

HUM LEVEL
<—60dB below fundamental

WEIGHT 17 lbs.

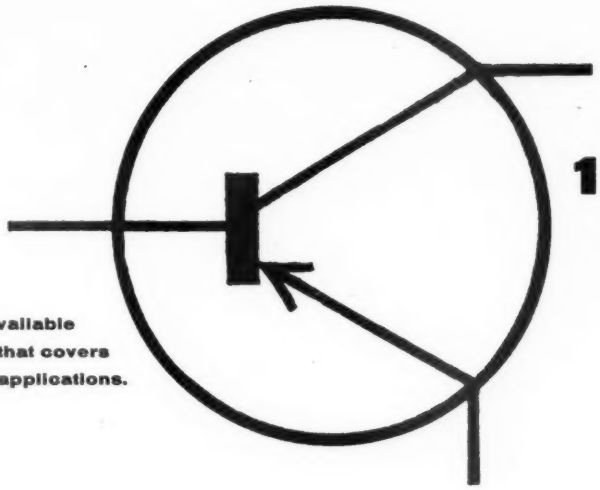
PRICE: £130

WAYNE KERR

WAYNE KERR LABORATORIES LIMITED, ROEBUCK ROAD, CHESSINGTON, SURREY. TELEPHONE: LOWER HOOK 1131

Three things you should know about EDISWAN transistors

MAZDA



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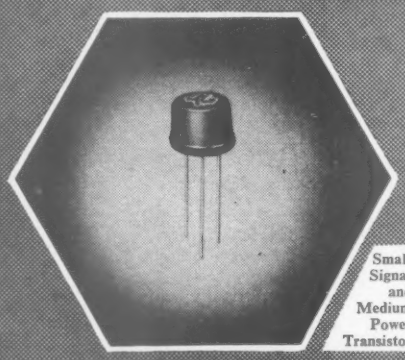
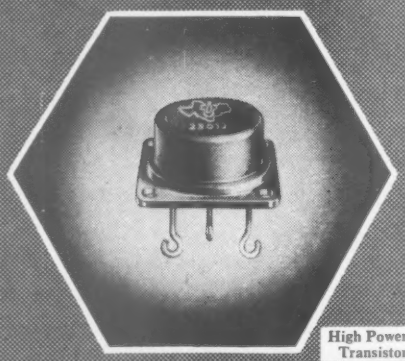
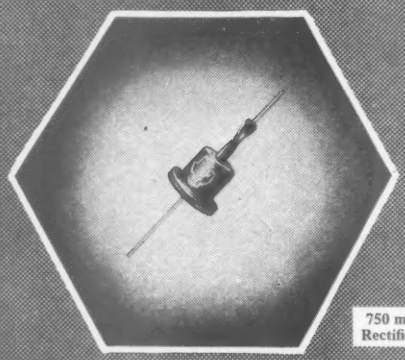


Small Signal and Medium Power Transistor



High Power Transistor



750 mA Rectifier

All illustrations are actual size

Silicon Transistors

Small Signal

This range of general purpose transistors is used for high gain, low level applications. Special features are :—negligible leakage current, a minimum alpha cut-off frequency up to 20 Mc/s, and a tetrode series providing 16 db gain at 30 Mc/s.

Medium Power

These 4-watt diffused base silicon transistors are ideally suitable for output stages in servo amplifiers. A pair in push-pull operation provide sufficient power to drive many types of servo motors. Two types are available, one with a maximum collector voltage of 60, the other of 100; the former is particularly useful for operating from 28-volt battery supplies.

High Power

Texas high-power transistors permit remarkable miniaturisation of power equipment. A collector dissipation of 37½ watts, with complete reliability, in such a small device, can only be achieved by using silicon. Furthermore, these transistors have a typical alpha cut-off frequency of 5 Mc/s.

Silicon Diodes

Medium Power Rectifiers

The new Texas diffused silicon technique has brought a fundamental change in semiconductor rectifiers. Peak inverse voltages up to 600 are featured in each of two ranges now readily available:—a metal-case rectifier provides a mean rectified current of 750 mA, and a glass-seal type provides 400 mA together with a forward to reverse current ratio of $2 \times 10^6 : 1$.

Computer Diodes

These miniature glass sealed diodes have a maximum recovery time of 0.3 micro sec with a forward current rating of 100 mA; there are three types with P.I.V. ratings of 50, 100 and 150 volts. The capacitance is 2.7 pico-farads at – 10 volts, 1 megacycle.

Complete data sheets are available on request.

TEXAS INSTRUMENTS LIMITED

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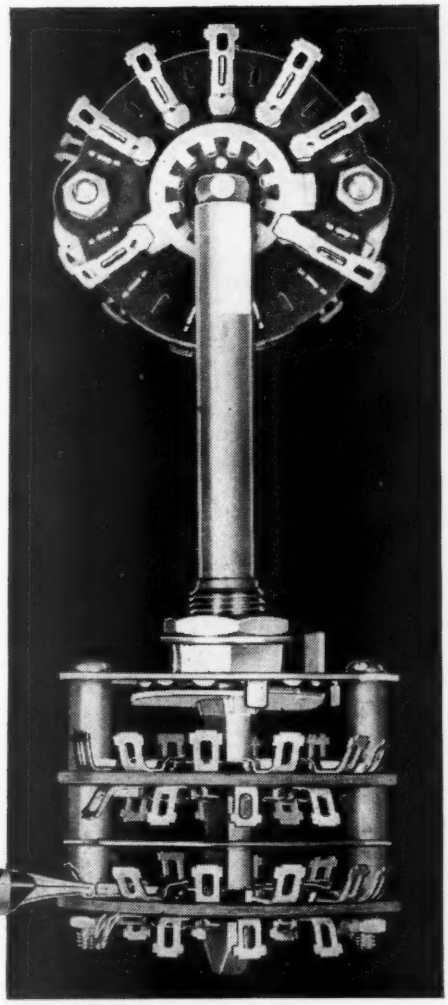
A Switch Idea —that's near perfection



Introduced to Britain by Plessey, the unique principle of 'Wedgelock' fixed contacts in switch construction has gained nation-wide acceptance, and an ever-increasing number of manufacturers are now specifying Plessey 'Wedgelock' Switches for many applications. Contacts are '*Wedgelocked*' into the stators which are securely held to guarantee positive location in all switching positions. Continuous contact efficiency is assured because even excessive tangential pressure will not distort the contact clips.

Design Engineers who have not yet received a copy of the new, comprehensive Plessey Switches Catalogue are invited to send for Publication No. 922.

PLUS POINTS of G.A.1. Switches are:

- ✳ **Double-wiping, self-cleaning contacts**
- ✳ **Accommodation for up to 22 insulated contacts per wafer**
- ✳ **Up to 12 positive positions can be utilised —30° indexing (a special 60° index plate can be supplied if required)**
- ✳ **Provision for unusual circuit arrangements**
- ✳ **Single- or multi-wafer construction**
- ✳ **Variable overall dimensions**
- ✳ **Provision for electrostatic screening by metal shields between adjacent banks**

Plessey

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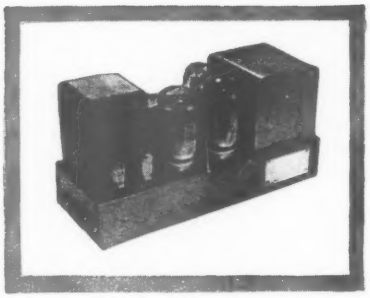
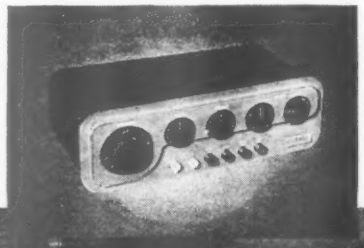
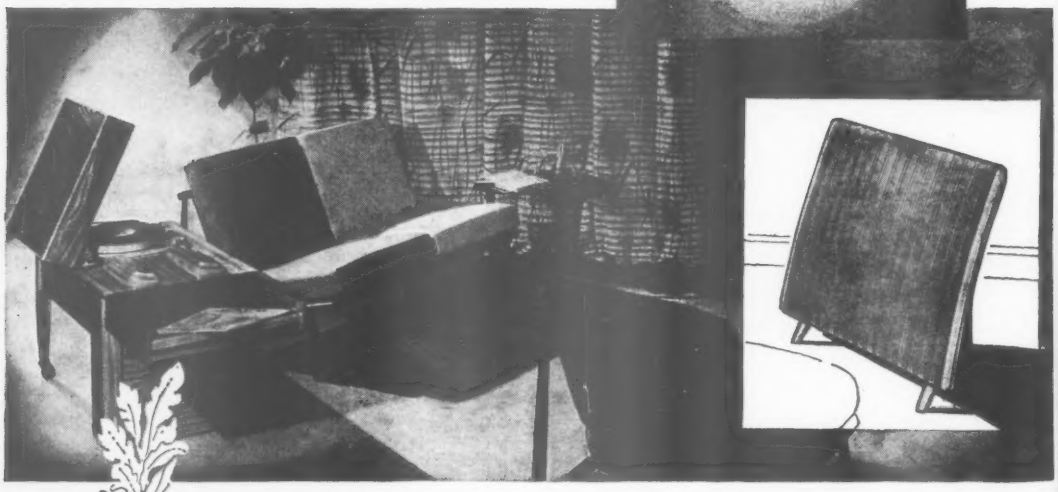
For the closest approach to the Original Sound— that your enjoyment and appreciation of music may be unimpeded







Please ask for illustrated literature describing the QUAD II Amplifier, FM Tuner and Electrostatic Loudspeaker.

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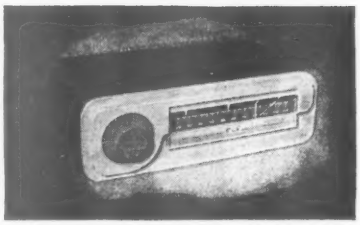
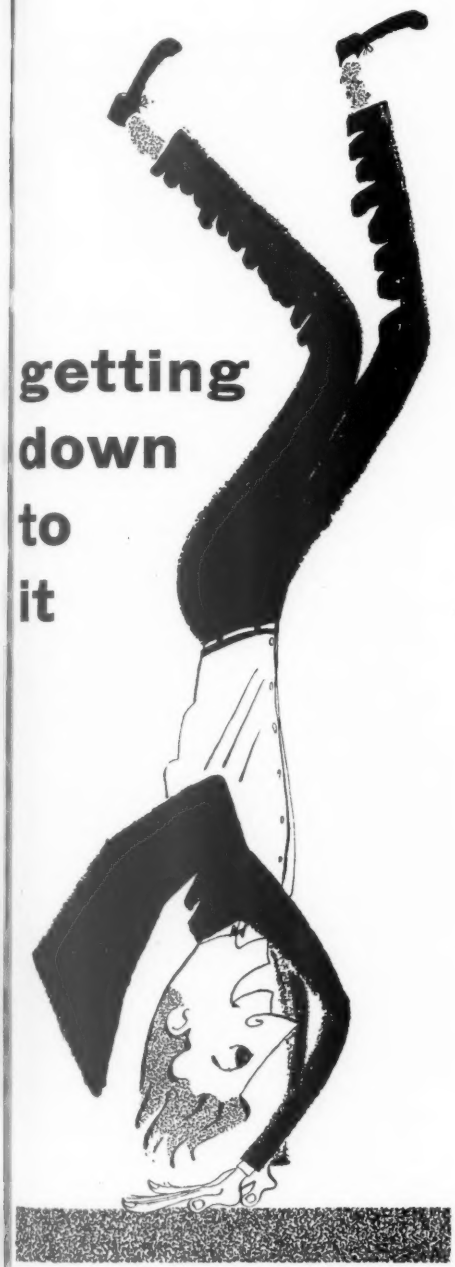
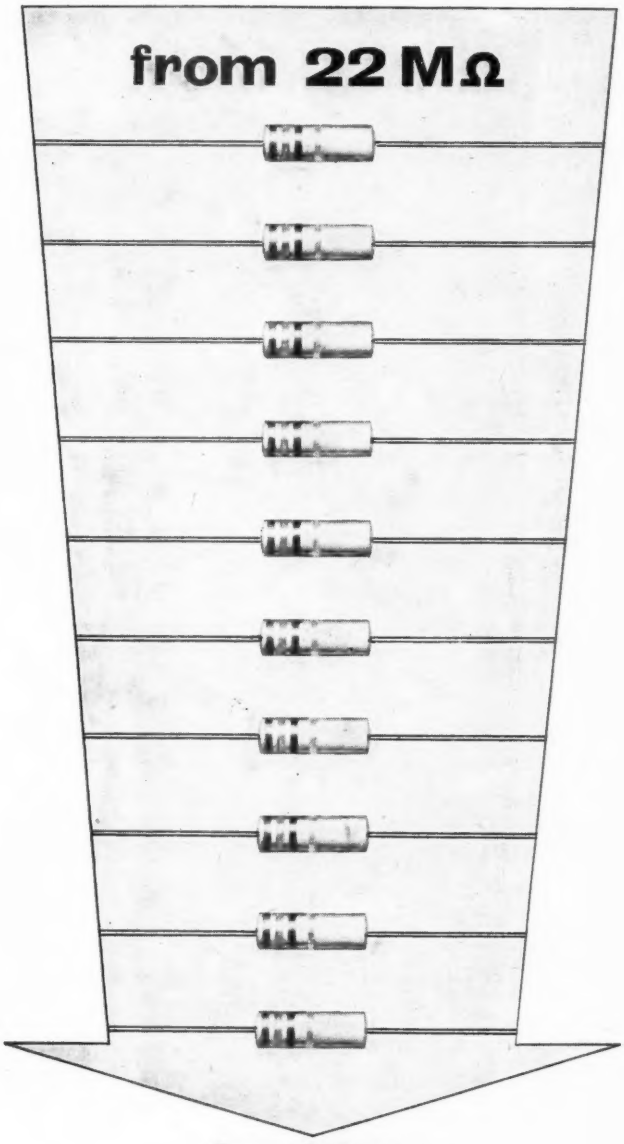


TEST ENGINEERS *please see our advertisement in the Situations Vacant columns.*





to 10 Ω

We are pleased to announce that our range of BTA (1W.) and BTS (½W.) resistors has been extended down to 10Ω. We can now supply these resistors from stock in the preferred values from 10Ω to 22MΩ.

Please write for full details.

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DUBILIER CONDENSER CO. (1925) LTD., DUCON WORKS, VICTORIA ROAD, NORTH ACTON, LONDON W.3.
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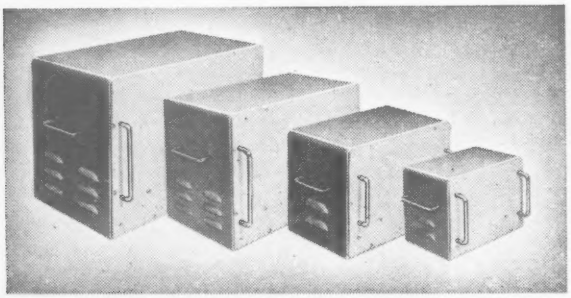
DN 204A

QUALITY *backed by experience*



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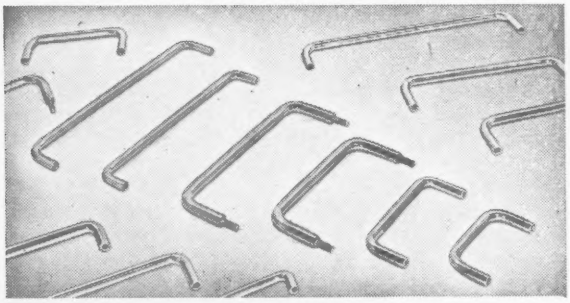
Attractively constructed of seam welded steel, these strong instrument cases are well ventilated and stove enamel finished in various colours. Available in four standard sizes or to your own specification.



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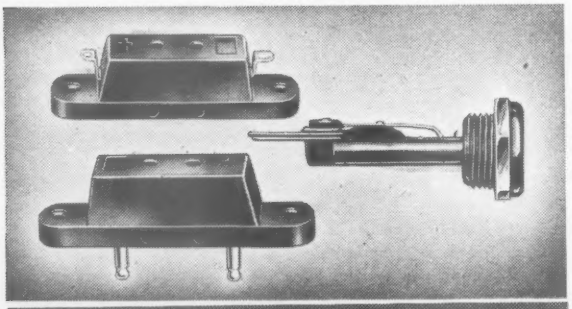
Made in standard range (4in., 6in., 8in. and 10in. centres). A wide variety of other sizes can be made to special order.



AMP-CHECKS

Invaluable device designed to facilitate current measurements. Installed in series with an electrical (or electronic) circuit to all points where measurements or checks are required without open circuiting.

Other products include
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Metal components available to customer's specification and small or batch quantities undertaken.

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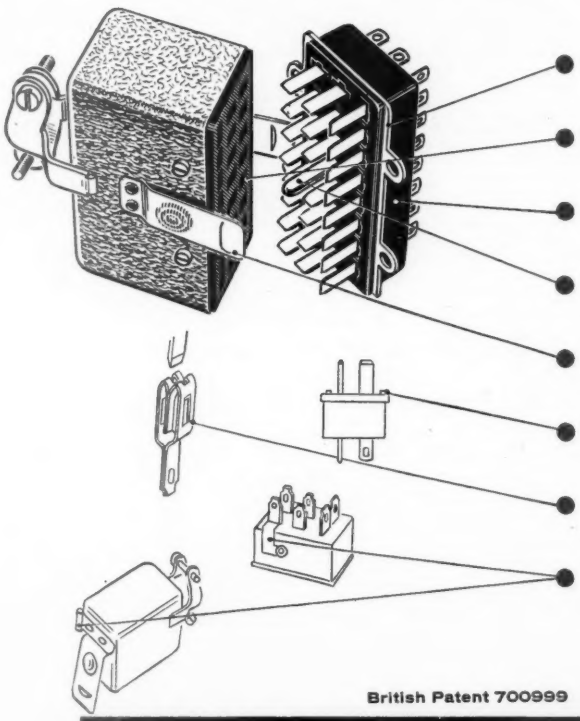
"MULTICON" PLUGS AND SOCKETS

The full range consists of 2, 4, 6, 8, 10, 12, 18, 24 and 33-pole sizes. Illustrated is the 24-pole size.

Working voltage: 1,000 volts D.C. or A.C. (peak) or 500 volts D.C. or A.C. (peak) in tropical use.

Current rating: 5 amps. D.C. or A.C. (R.M.S.) per contact.

Average contact resistance: below 0·002 ohms.



Metal flanges moulded into the body to ensure flush mounting and to avoid alignment difficulties.

Terminal numbering moulded into plug and socket bodies to facilitate wiring and cableform testing.

Single-piece nylon-filled body mouldings provide high insulation and tracking resistance.

Large pin locator contact facilitates engagement, especially in unitor applications.

Optional vibration-proof retaining blades to secure the unit to panel or chassis.

Four distance pips keep mating faces apart and eliminate moisture traps between plug and socket faces.

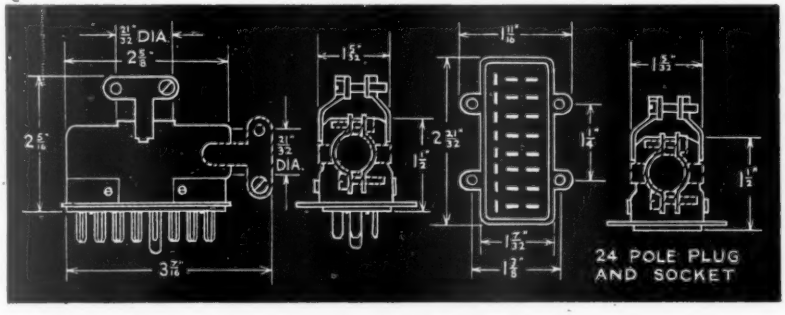
Socket clips have split limbs with four areas in contact with each plug blade ensuring absolute reliability of contact.

Earthing of plug or socket covers is achieved by either:

internal connecting link from a contact to cover, OR

rivetted earth tag to outside of cover.

British Patent 700999



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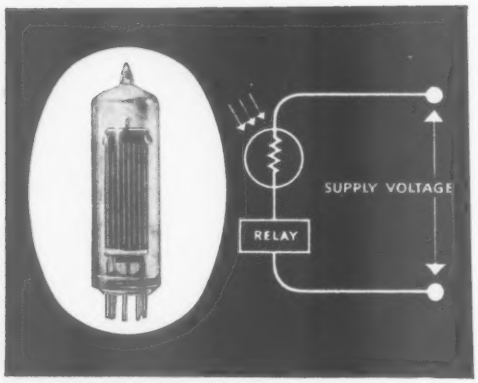
20,000 times more sensitive than an ordinary photocell



New cadmium sulphide technique revolutionizes photocell performance

A new type of photocell with an entirely new order of performance has been developed in the Mullard Solid State Physics Laboratories and is now about to go into production.

Employing a large area cadmium sulphide photosensitive element, the new cell provides a sensitivity approaching that of a photomultiplier . . . *and* a current handling capacity of tens of milliamps.

Technical information is in the course of preparation and you are invited to write to the address below.

Robust relays operated without amplifiers

At the extremely low illumination of 5 ft. candles, robust relays can be operated direct from 40 volt supplies.

Low dark current

In typical applications the ratio of light to dark current is in general more than 10,000 : 1.

Wide spectral response

The usable response extends through the entire visible spectrum to the near infra-red and peaks in the yellow/red region.

A.C. or D.C. operation

The cadmium sulphide type of photocell is non-polar and can be used with either a.c. or d.c. supplies.

Sturdy construction

Like many other solid state devices, the new type of cell is inherently rugged and suited for industrial use.

Wide range of applications

Flame failure detection, door opening, street lighting control, conveyor control, illumination control and smoke monitoring are only a few of the many possible applications.

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Mullard
COMMUNICATIONS AND INDUSTRIAL VALVE DEPARTMENT

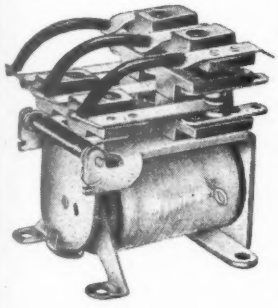
Mullard

MVT 344b

Thorn

Vibration-proof relays

FOR AIRCRAFT AND INDUSTRIAL USE



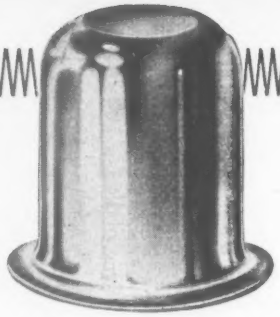
These relays of simple and robust construction are designed to work under adverse conditions. The use of such features as high contact pressures and generous wiping action enable them to comply with the Service requirements of DES.1 and DEF.5000.

Both sealed and open types are available with up to 4 pole changeover contacts. The standard relays operate on 28 volts D.C. and enquiries for other operating voltages are welcome. Hermetic enclosure of the sealed types ensures complete freedom from the effects of humidity, altitude and tropical exposure. Also the case protects the relay from mechanical damage and operator interference.

SWITCH 10 amps A.C. (115 volts) or D.C. (28 volts)

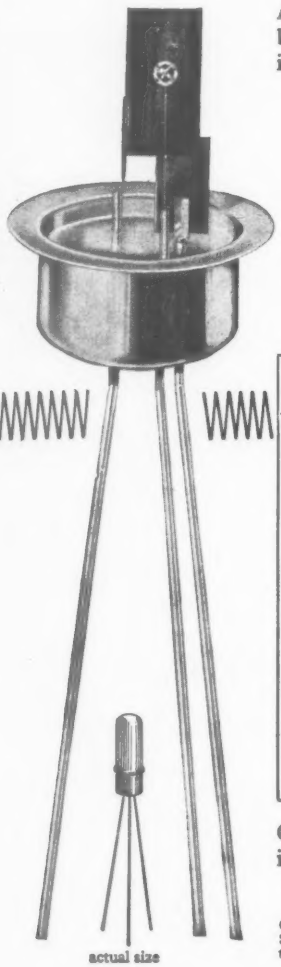
Thorn

THORN ELECTRICAL INDUSTRIES · AIRCRAFT COMPONENTS DIVISION
GREAT CAMBRIDGE ROAD · ENFIELD · MIDDLESEX · Tel: ENFIELD 5353



high frequency

SURFACE BARRIER TRANSISTORS



actual size

A new wide range of high frequency applications can be transistorised with the surface barrier transistors now in production for the first time in Great Britain at the new Swindon factory.

They feature:—

- **real power saving—typical amplifier consumption less than 2 mW per stage**
- **manufacturing techniques backed by Philco Corporation's 3 years of mass production experience**
- **circuit design information drawn from the use of several million similar units in the U.S.A.**
- **reliability and uniformity guaranteed by the use of automatic production equipment in ideal environmental conditions**

Type No.	*Application*	*f max greater than*
2N 344	*General purpose high frequency transistors*	
2N 345	*for use as RF, IF and video amplifiers, converters and in switching circuits.*	*30 Mc/s.*
2N 346	*Of similar application to 2N 345 but where very high frequency is the most important consideration.*	*60 Mc/s.*
2N 128	*Designed primarily for critical military*	*45 Mc/s.*
2N 129	*applications calling for extreme reliability under the most adverse environmental conditions.*	*30 Mc/s.*
2N 240	*A hermetically sealed surface barrier transistor for use in computer circuits. This unit has controlled saturation characteristics and low saturation resistance.*	*30 Mc/s.*
	Note f max = maximum frequency of oscillation	

Other types of Semiconductors high frequency transistors include micro-alloy, micro-alloy diffused and silicon alloy; also germanium power transistors.

Comprehensive data sheets and application notes are available for all Semiconductors transistors. Engineers and senior executives are invited to write for copies, stating the types of transistor or applications in which they are interested.

CHENEY MANOR, SWINDON, WILTS.
Tel: Swindon 6421/2

Semiconductors Limited

S.C.5

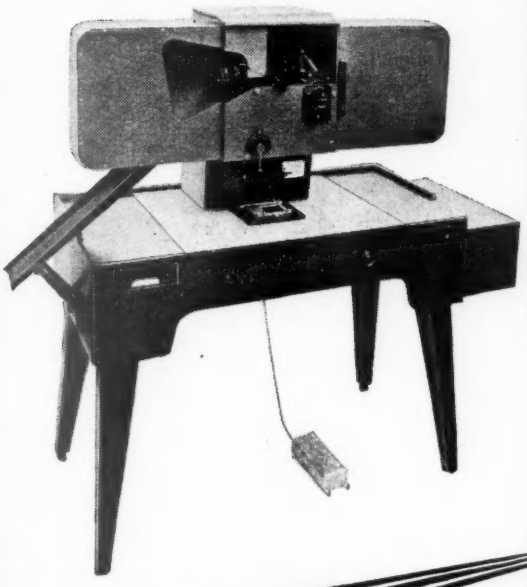


PHOTO CELLS IN ACTION

TYPE VA 26T

The Ilford Kenprinter* one of the most modern and versatile pieces of photo finishing equipment produced, employs a 'Cintel' Photocell for exposure control.

This cell is but one from a wide range in current production suitable for photographic applications; in fact there is a 'Cintel' Photocell for almost every known application.

* *Photograph by courtesy of Ilford Ltd., Ilford, Essex.*

*** over 100 cell types in the current catalogue. Full data on request.**

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LOWER SYDENHAM · LONDON SE26
A Company within the Rank Organisation Ltd. **HITHER GREEN 4600**

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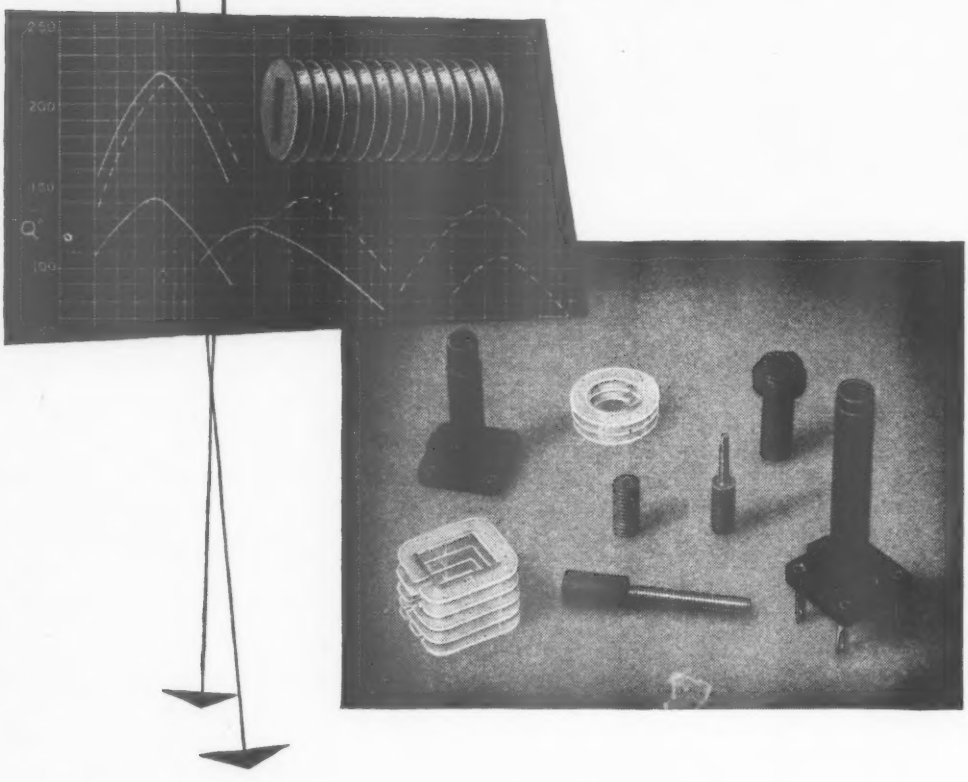
GECALLOY



screw cores

Gecalloy screw cores for Radio and Television application provide an inexpensive and simple method of inductance adjustment.

Moulding in three types of insulated powdered iron produces cores with the highest resistivity, ideal for H.F. and V.H.F. working.

Available in three grades: M.E. for frequencies from 100 Kc/s to 50 Mc/s
M.F. for frequencies from 5 Mc/s to 200 Mc/s
M.A. for frequencies from 50 Mc/s to 300 Mc/s

A comprehensive range of bobbins also available

Write for leaflets giving full technical details.

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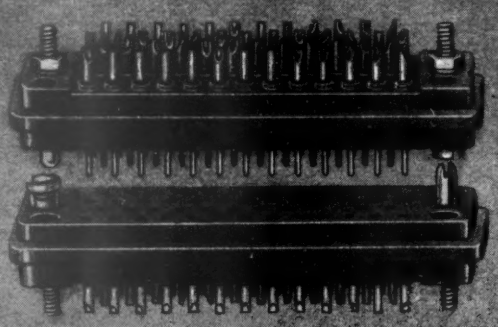
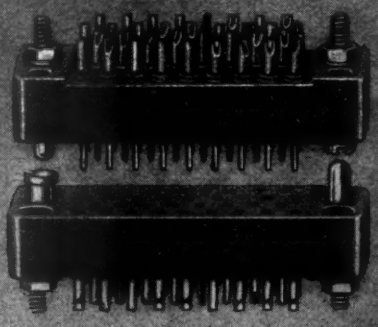
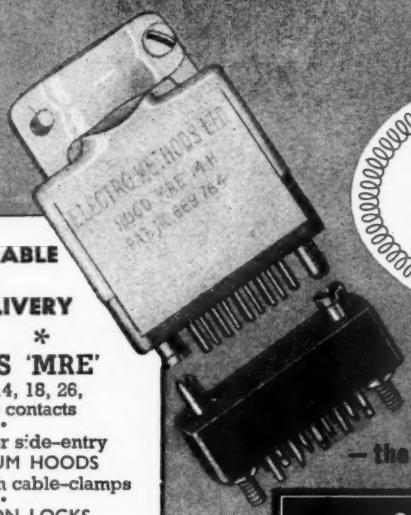




These Units are ACTUAL SIZE —made under U.S licence from Winchester Electronics Inc.



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miniature connectors

NOW AVAILABLE FOR PROMPT DELIVERY

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SERIES 'MRE'
with 7, 14, 18, 26, 34 & 50 contacts

Rig'd top or side-entry ALUMINIUM HOODS complete with cable-clamps

VIBRATION LOCKS for 7 to 34 contact top-entry hoods only

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SERIES 'SMRE'
with 7, 14, 20, 26, 29 & 34 contacts

Rig'd top-entry ALUMINIUM HOODS complete with cable-clamps

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SERIES 'M'
with 5, 7 & 9 contacts

Rigid top-entry MELAMINE HOODS complete with cable-clamps

Locking device optional

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SERIES 'SM'
with 1 & 2 contacts

Rig'd top-entry MELAMINE HOODS

GOLD-PLATED CONTACTS
made from spring-tempered phosphor-bronze
provide low contact-resistance, prevent corrosion and facilitate soldering.

MELAMINE MOULDINGS
conforming to B.S.S. 1322
provide high arc-resistance, high dielectric and mechanical strength.

Full technical data and illustrated leaflets forwarded on request:
ELECTRO METHODS LTD.
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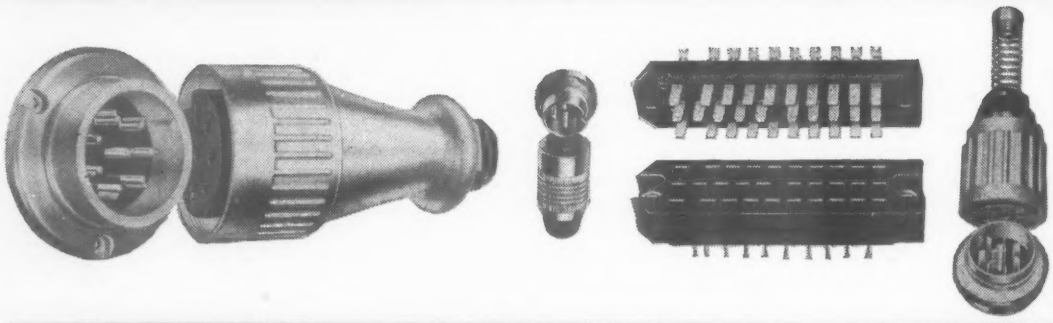
Telephone: Stevenage 780

Performance proved since 1939 — the patented 'Tuchel' contact principle is a feature of the Modac range of connectors

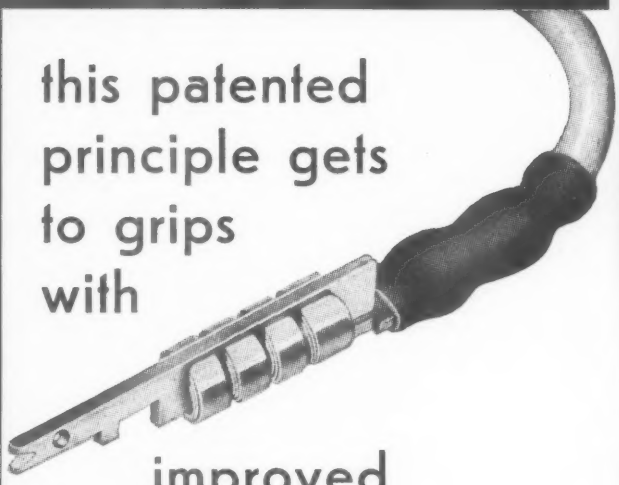


Within the MODAC range of connectors are available strip type, miniature, general service and heavy duty designs to meet most needs and applications.
The full technical data is set out in this new, completely illustrated brochure, a copy of which may be obtained on request.

Send for this new and fully illustrated brochure

MODERN ACOUSTICS LIMITED
CONTACT CONNECTORS DIVISION
MANOR WAY • BOREHAM WOOD • HERTS
Sole concessionaires of Tuchel in Great Britain and Commonwealth Countries.

this patented principle gets to grips with improved contacting

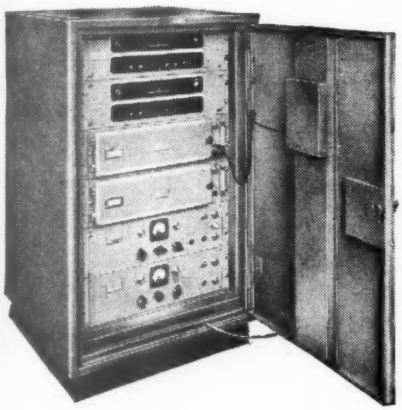


Each pin on every Modac connector is gripped by up to 24 self-cleaning resilient pincer-like contacts which ensure the firmest mating and maintain clean and oxide-free surfaces. Modern Acoustics will be pleased to undertake the design of any special plug and socket arrangement to meet specific needs.

MA 1

A low cost F.S.K. link

Plessey



Type PVR. 102 Fixed Station Diversity Radio Teleprinter Receiving Terminal for H.F.

Designed in collaboration with International Aeradio Limited, the type PVR 102 Series Terminal has been introduced to provide an inexpensive radio teleprinter receiving equipment wherever some degree of manual control is acceptable. It is particularly suitable for regional point-to-point communications and meteorological broadcasts at Airports and for Press Agency and similar work.

Due to its low initial cost and its relatively simple installation, the terminal now offers radio teleprinter communications for use in circumstances where financial considerations have previously made them difficult to justify.

FEATURES

Built-in metering arrangements provide for checking, setting-up and monitoring of all important circuit functions.

Direct operation of up to three teleprinters; no keying relays are used, thus ensuring maximum reliability and freedom from radio interference. Five separate channels are pre-set and crystal controlled. Provision of crystal trimmers ensures that frequency is exact. Change of channel is effected by the operation of one knob.

Channel selector switch can be motor-driven from the rear, thus permitting remote control. A remote channel selection unit is available.

F.S.K. transmissions of differing shifts are catered for by the use of linear discriminator covering 200–850 CPS.

Rapid diversity switch action on small signal differential over wide range of inputs. Complete supression of weaker diversity signal.

A brochure setting out extensive technical data concerning the PVR 102 Series Terminal is available on request. Please ask for Plessey Publication No. 789/1.

ELECTRONIC AND EQUIPMENT GROUP

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Overseas Sales Organization: Plessey International Limited · Ilford · Essex · England · Tel: Ilford 3040

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A demonstration will prove to you that the results obtained from our "Symphony" amplifiers, Tuners, Tape Recorders, etc., are of the highest order. This is coupled with sheer long-term reliability.

HOW IS ALL THIS POSSIBLE? We are not subsidised by the State or other body. It is possible because WE SUPPLY DIRECT TO THE PUBLIC and give you what would otherwise be discount to the Trade.
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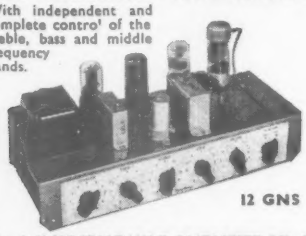
With independent and complete control of the treble, bass and middle frequency bands.



12 GNS

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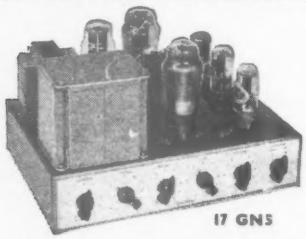

17 GNS

"SYMPHONY" AMPLIFIERS with REMOTE CONTROL

Enables the amplifier proper to be set in the bottom of a cabinet whilst the controls are mounted conveniently higher up. **2 GNS extra.**

No. 2 PUBLIC ADDRESS AMPLIFIER Mk. III 15 GNS.

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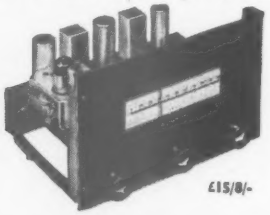

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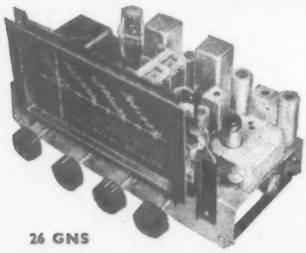
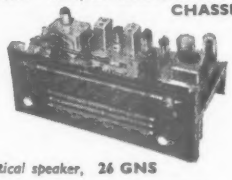


26 GNS

"SYMPHONY" AM/FM RADIOGRAM CHASSIS



including elliptical speaker, **26 GNS**

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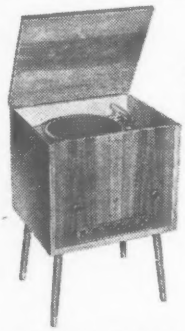

"Symphony" Amplifier, FM Tuner and Lenco Unit in Nordyk Cabinet. Size 20in. wide x 17in high x 17in. deep, at **9 GNS** complete with legs.

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"SYMPHONY" TAPE RECORDERS

Table Model 52 GNS

Portable Model 52 GNS

TAPE EQUIPMENT by:
Truvox, Collaro, Grundig, Wearite, Ferrograph, Brennell. TAPE—all makes stocked.

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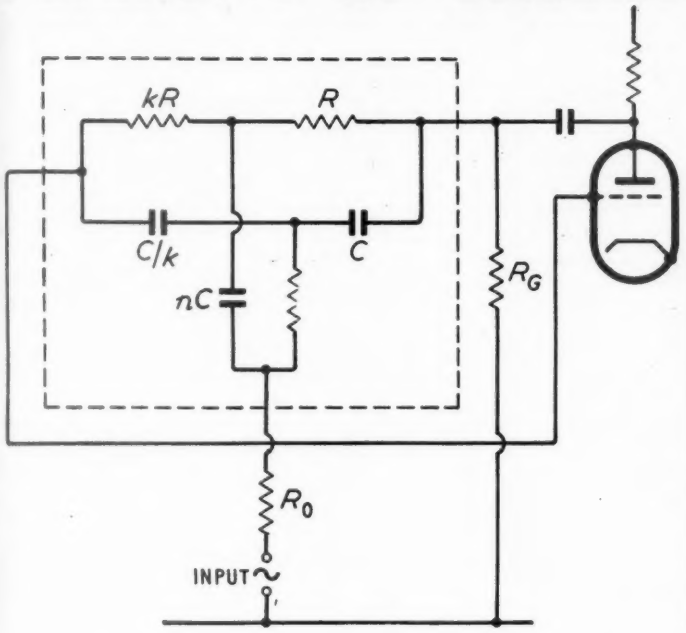
Occasionally one or two slightly shop-soiled, demonstration tape recorders are available (except "Symphony") at substantial discounts.

Parallel-T RC Selective Amplifiers



A form of RC selective amplifier for low-frequency use is described in the April issue of *Electronic & Radio Engineer*. Unlike most other types, it is designed for use with a signal source of low impedance. Equations for the computation of performance are given and design is illustrated by a 50-c/s amplifier.

Original articles by leading authorities are a prominent feature of ELECTRONIC & RADIO ENGINEER. *Regular readership will keep you in constant touch with progress in the entire field of electronics, radio and television.*

POST THIS COUPON TODAY

ARTICLES IN THE MAY ISSUE WILL INCLUDE . . .

MEASUREMENT OF WOW AND FLUTTER IN TAPE RECORDERS

A simple method is described, the only equipment required being a stable audio oscillator and a triggered oscilloscope with facilities for sweep expansion. The oscillator output is recorded, played back, and the wow and flutter calculated from measurements on the playback-signal waveform.

PARALLEL-PLATE TRANSMISSION LINES

The connection between parallel-plate transmission lines and radiators is established mathematically. It is shown that an exact relationship exists between such transmission lines and radiators with at least one infinite dimension.

ALSO

The unique monthly Abstracts and References feature compiled by the Radio Research Organization of the Department of Scientific and Industrial Research.

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Racal announce the first in the 'field' low priced Single Sideband 60W Radio Telephone

TRA.55 Transportable

ABRIDGED SPECIFICATION

Frequency range:	3-12 Mc/s
Channels:	4 crystal controlled (2 in band 3-6 Mc/s) (2 in band 6-12 Mc/s)
Output power:	60 watts P.E.P. continuous rating.
Aerial:	2 outputs: (a) 75 ohm for tuned aerials (b) single-ended output for long wire untuned aerials
Finish:	High grade tropical standard for ambient temperature of 40°C
Power supply:	100-125 and 200-250V 40/60 c/s AC supply Consumption: 36vA standby 95vA receiver only 180vA receiver with transmitter available 300vA full-power transmission
Dimensions:	Width 20½ inches (52 cms) Height 24½ inches (62½ cms) Depth 20½ inches (52 cms)
Weight:	Approx. 160 lbs. (72.6 Kg)

- ★ Equivalent to Radio Link 600W on DSB
- ★ 4 pre-set crystal controlled channels
- ★ Frequency range: 3-12 Mc/s in 2 bands
- ★ 60W P.E.P. continuous rating
- ★ Extreme simplicity of operation
- ★ Transportable
- ★ May be used for CW operation

The enormous effective gain in power obtained by SSB transmission is now available in compact and economical form, especially suited to the needs of colonial communications authorities, geological survey teams, meteorological services, mining companies, oilfields, civil aviation and overseas armed forces.

The TRA.55 is tropicalised and designed for use by unskilled personnel, the transmitter and receiver being tuned simultaneously to 4 pre-set channels, selected by a single switch. The R/T transmit switch is incorporated in the handset handle. International-type valves and connector are used throughout.

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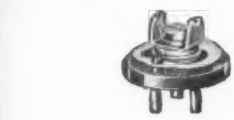
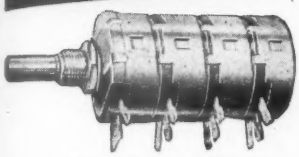
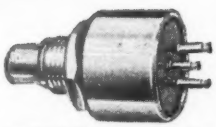


Preset Mk. 2 G type



Type E four gang variation

Preset Mk. 5 G type



MH2 Miniature panel and Spindle Sealed

Type E gang with Switch

Type EN to RCS 1000

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for special applications

Moulded track potentiometers by Plessey possess a high standard of stability within a wide range of operational temperatures and can be stored for extended periods without deterioration. They can be manufactured to conform, within strictly specified limits, to a designed pattern of values at various positions on the track.

COMMERCIAL TYPES

These are available as single units, dual concentrics or special gangs and are available with or without double pole switch, also in preset form. The standard resistance values are linear 100 ohms to 5 MΩ, log 5KΩ to 2 MΩ. The maximum working voltage is 500V.

Standard Type 'E'. 2 watts at 70°C for linear laws.

Standard with double pole switch Type 'ES'. 2 watts at 70°C for linear laws.

Dual Type 'ED'. 2 watts at 70°C for each section.

Dual with double pole switch Type 'EDS'. 2 watts at 70°C for each section.

Preset Type 'EP'. 1 watt at 70°C for linear laws.

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Available as normal and preset types. In general are in accordance with the appropriate Ministry Specifications. Panel and Spindle Sealed Type 'EH2' 1 watt at 100°C for linear laws. (Type Approval Certificate 906/4 [1230].) Maximum working voltage 500V.

Instrumentation Type 'EN' 2 watts at 70°C for linear laws. (All materials to R.C.S.1000.) Maximum working voltage 500V.

Miniature, thumb operated, with switch, Type 'F' ½ watt at 70°C for linear laws. Maximum working voltage 250V. Sub-Miniature Preset Type 'G'. Marks 2 & 5. ¼ watt at 70°C for linear laws. (Type Approval Certificates 974/2 and 1075/1 [1373].) Maximum working voltage 250V.

Miniature Panel and Spindle Sealed Type 'MH2' ¼ watt at 70°C. (Type Approval Certificate 1032/1 [1373/1].) Maximum working voltage 250V. A fully sealed version of this potentiometer is also available.

Rating at 100°C is normally one half of that at 70°C.

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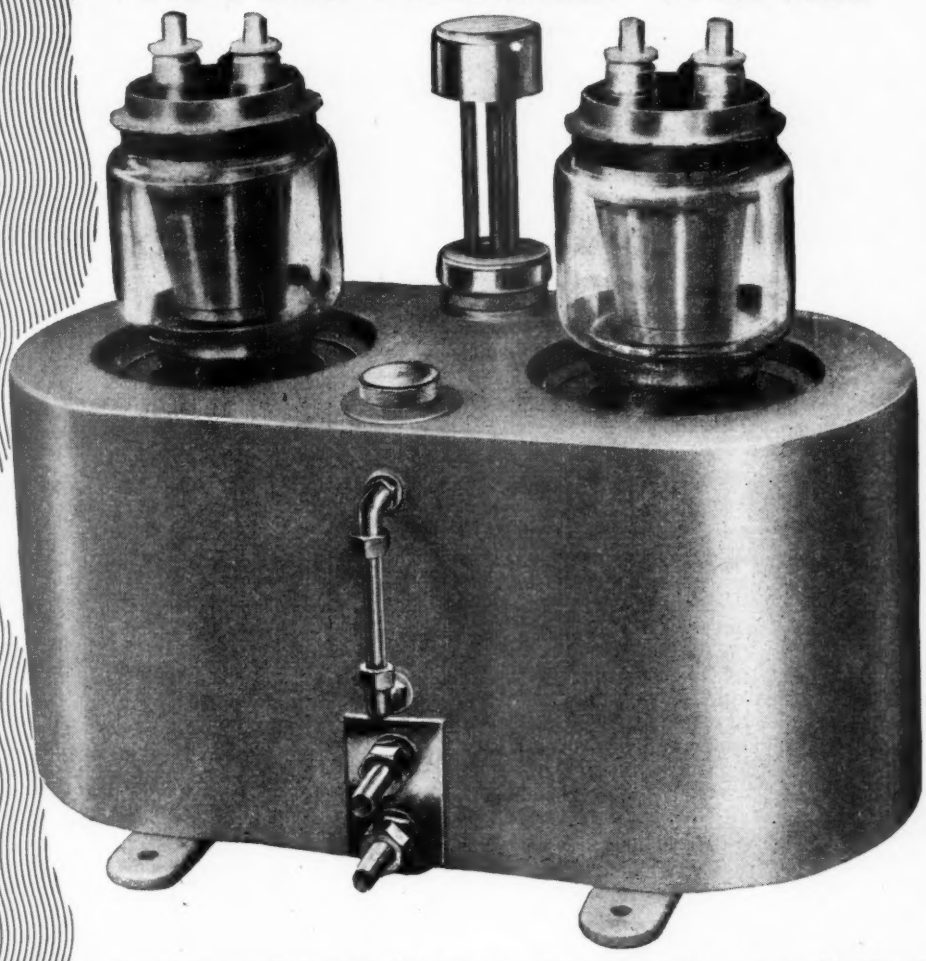

Conditions sometimes exist both in industry and in communications where neither forced air cooling nor water cooling of high power valves is entirely satisfactory. Air may be so dirt laden that the cleaning of filters and radiators calls for undue effort and cost and at the same time water may be expensive, scarce or otherwise unsuitable.

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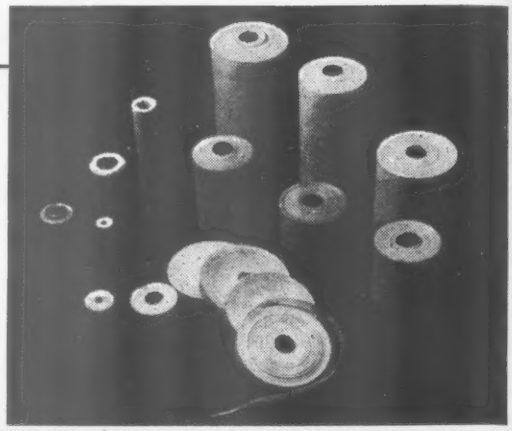

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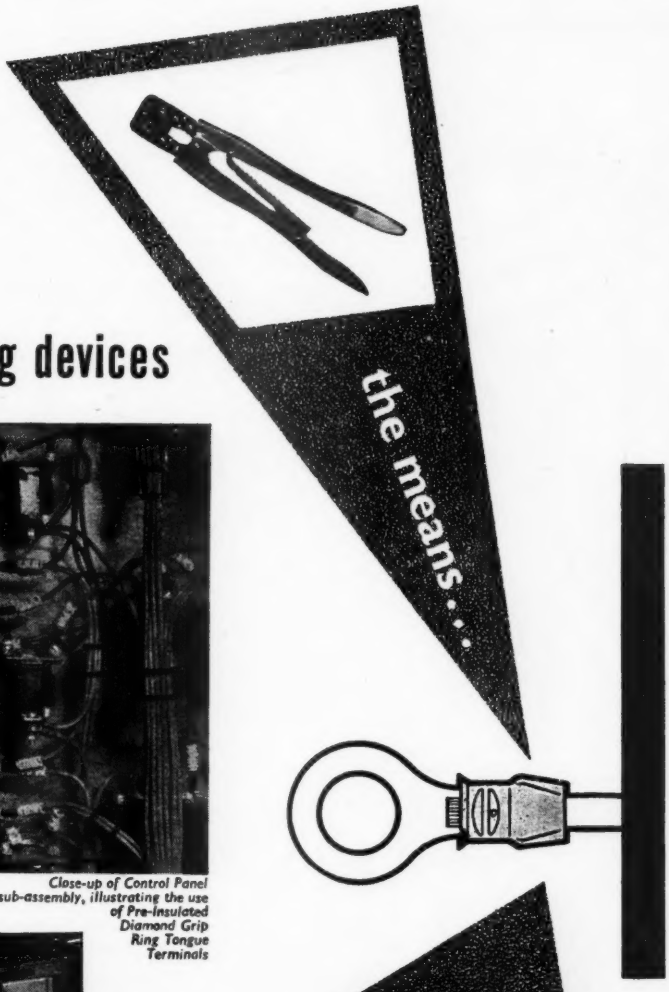
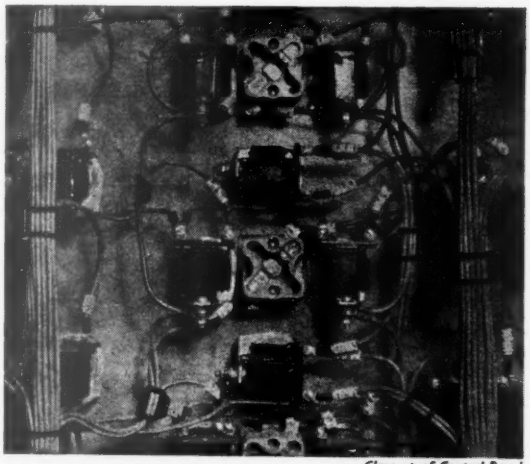
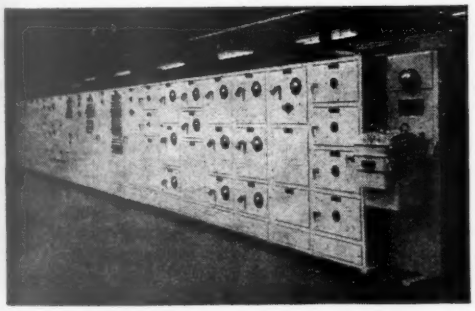




Close-up of Control Panel sub-assembly, illustrating the use of Pre-Insulated Diamond Grip Ring Tongue Terminals



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The Telcon Metals Division is pleased to announce that it has now in production a standard range of MUMETAL Shields for Cathode Ray Tubes of the more popular types made by leading manufacturers such as CINTEL, COSSOR, DUMONT, EDISON-SWAN, ETEL, FERRANTI, G.E.C., MULLARD, and 20th CENTURY ELECTRONICS LTD. Details and drawings are available on request. Special Shields can be made to customers' specifications.

Rubber Masks are available from The Standard Insulator Co. Ltd., Camberley, Surrey, for use with these Mumetal Shields.

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Mozart

10 watt amplifier

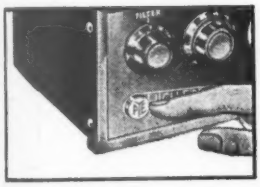
PRINTED CIRCUIT RELIABILITY

In chassis form (8¼ lbs.) or in open-work metal case (9 lbs.) Control panel in copper finish.

The new Pye Mozart is one of the smallest and most efficient 10-watt amplifiers ever devised. The chassis measures only 10¼" x 3¾" x 5". Its outstanding performance has been reached through good design and expert hand finishing. Leading technical writers have been unanimous in praise of its ingenuity. We reprint below some extracts from an article by Percy Wilson in 'The Gramophone'.

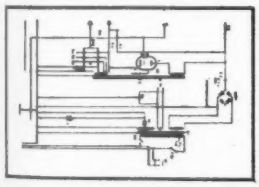
Dialomatic Selector

The Mozart has input facilities for records, tape and radio. New 'dialomatic' pick-up compensation unit gives instant matching for most types of pick-up.



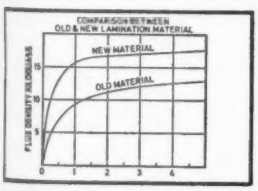
On/Off Push Button

This is completely separate from the volume control and eliminates all mains interference.



Simplified Circuitry

This brilliantly simplified printed circuit uses only 3 valves, a metal rectifier and a minimum of capacitors and resistors, allowing a great saving of space.



Improved Output Transformer

New grain orientated laminations have increased the efficiency and compactness of Mozart's transformers. Curves show how for given outputs, they can be operated at much higher flux densities.

"The performance is REMARKABLY GOOD"

P. Wilson writing in 'The Gramophone'

". . . this is one of the most interesting amplifiers I have seen in recent years."

". . . the chassis lay-out looks good and the arrangement on the printed circuit is particularly cunning."

". . . the circuit itself is both novel and flexible in the matter of control."

". . . the circuit controls are of the most satisfactory types that I know."

". . . we found ourselves unanimous in admiration of its ingenuity."

"The performance is remarkably good . . . one of my colleagues, indeed, was so impressed with the lay-out, components, workmanship and performance that he affectionately nicknamed it Pye's Pint Pot! By which I suppose that he means that it holds a quart."

The creative mind of the scientist . . . in the hands of the craftsman

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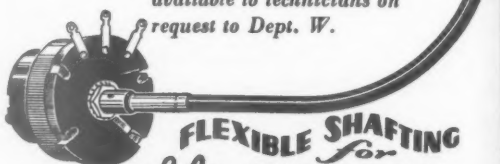

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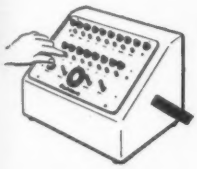

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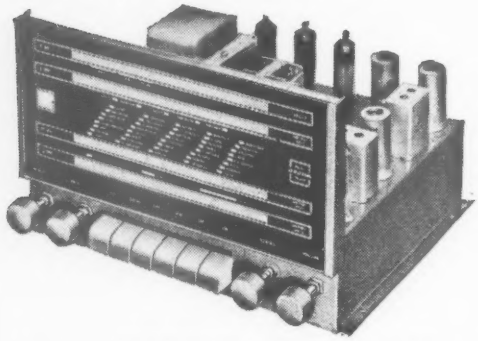

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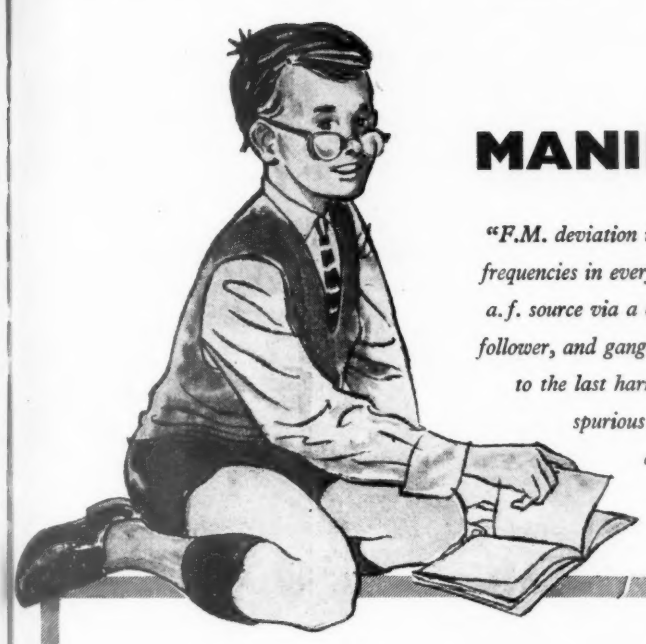

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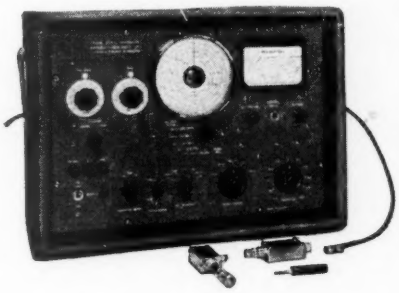
"F.M. deviation is maintained sensibly constant at all carrier frequencies in every band by feeding the reactor valve from the a.f. source via a continuously variable potentiometer, cathode follower, and ganged attenuating system, while A.M. is applied to the last harmonic multiplier in order to overcome the spurious f.m. often encountered when modulating an r.f. oscillator directly."

It's to be expected that a lad familiar with the exploits of Dan Dare, nuclear fission and analogue computors would be knowledgeable about a relatively simple instrument like the Marconi Signal Generator Type TF 995A/2—but are *you* as well-informed? Do *you* know that it has a frequency range of 1.5 to 220 Mc/s, and an output range of 200 mV to 0.1 μV? That it has a built-in crystal calibrator and direct-reading incremental frequency control? That it is F.M. or A.M.—or both, simultaneously? Such basic facts about what is a standard unit of telecommunication test equipment should be known to every electronic engineer. If you don't know them, don't be too shy to admit it—write for leaflet G111 which describes this Signal Generator in detail.



FM/AM SIGNAL GENERATOR
Type TF 995A/2

1.5 to 220 Mc/s; crystal check facilities from 13.5 Mc/s upwards. Output: 0.1 μV to 100 mV at 52 and 75 ohms, and up to 200 mV at 75 ohms. Internal 1000-c/s modulation: a.m., variable up to 50% depth; f.m., variable up to 25 and 75 kc/s deviation on all r.f. ranges, also greater max. deviations—up to 600 kc/s on the highest range. External modulation; f.m., up to 15 kc/s modulation frequency; a.m., up to 10 kc/s.

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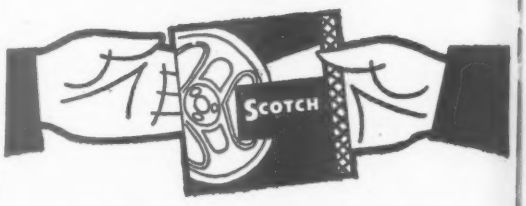

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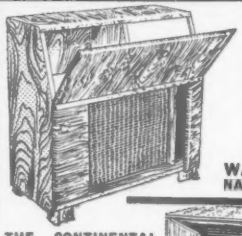

THE BUREAU

This popular bureau cabinet is veneered with the finest selected Walnut and beautifully polished in a medium shade. Designed to accommodate almost any of the many units we have available and to give generous storage compartments.

WALNUT £16.16.0
NATURAL OAK £18.18.0

"PRELUDE"

This most attractive cabinet has been designed to utilise natural acoustic properties of the walls, and is ideal where space saving is a consideration.
Will take 8in. or 10in. speaker unit with provision for Tweeter Unit (12in. speaker cabinet also available).

Packed Flat. **£10.10.0**

THE SERENADE

Veneered with finest selected walnut, beautifully polished to a medium shade; this attractive cabinet has generous storage space, with board sliding out smoothly on metal rollers.
This cabinet can be fitted with any of the latest Hi-Fi Units.

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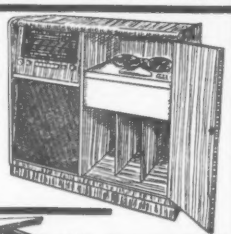

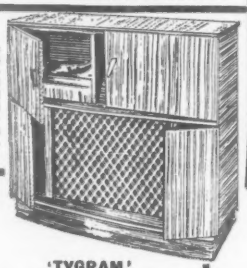

THE CONTINENTAL

This elegant Cabinet is the latest in our range designed in the continental style, solidly constructed and finished in selected mahogany veneers. Available medium, light, high gloss or contemporary finish.

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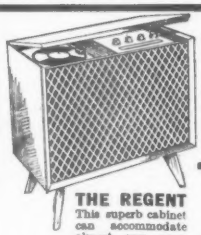

THE CONTEMPORARY

This beautifully made cabinet is oak veneered with mahogany interior and is waxed finished. Available in any shade to order at slightly extra cost.
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'TYGRAM'

This smart-looking cabinet is available with or without legs. Can accommodate any type of turntable (including transcription or autochanger units).
The unit also accommodates any type of amplifier, plus most radio tuners. **9 gns.**
without legs **£7.14.0**

WE ALSO CARRY A LARGE RANGE OF EQUIPMENT

See Page 90

We supply all units and can fit any cabinet with the latest Hi-Fi amplifiers, tuners, transcription units, record changers, speakers, etc., all available on easy H.P. terms. Send for our new comprehensive illustrated catalogue.

THE REGENT

This superb cabinet can accommodate almost any combination of Radio Feeder Unit, Amplifier Control Unit, Motor Unit and Loudspeaker System. There is adequate storage space. Veneered with finest selected walnut & polished. Has a pneumatic lid and ball bearing castors.

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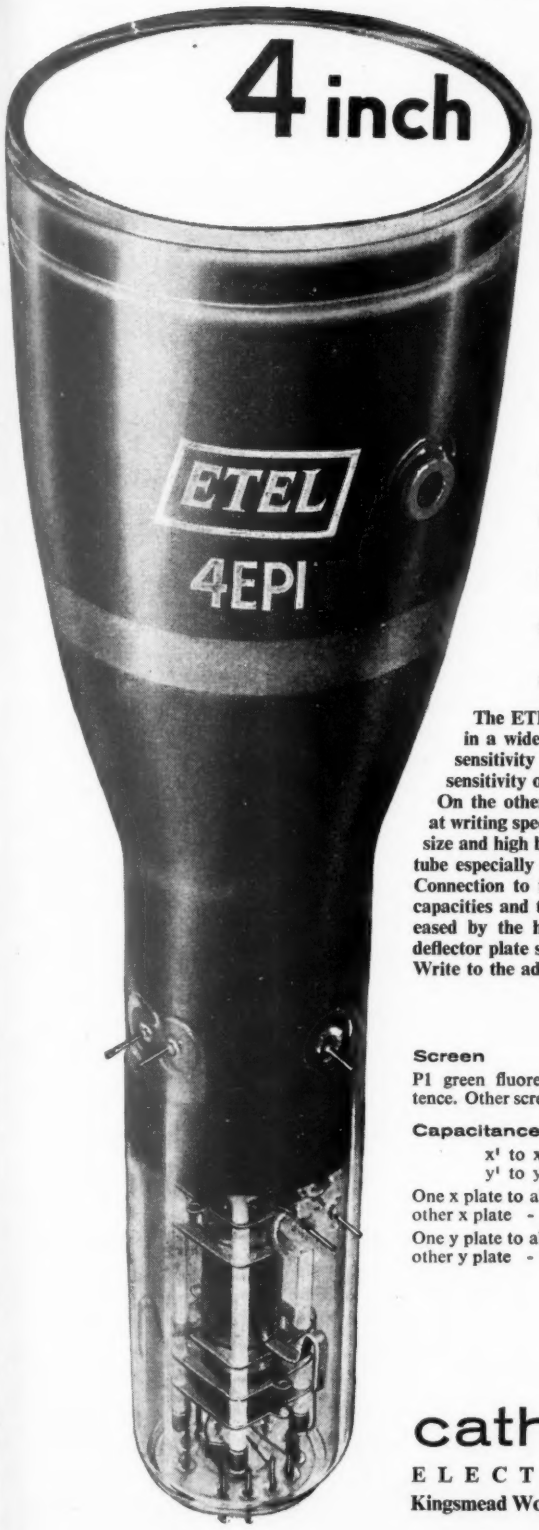

4 inch high quality general purpose instrument tube 4EPI

- ✳ High Frequency Operation
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- ✳ Good Definition
- ✳ Precision Flat Screen

The ETEL 4EP1 is a high quality instrument tube which can be used in a wide variety of applications. For example, where high deflection sensitivity is needed, an overall acceleration of 2kV will result in a sensitivity of 1mm/volt.

On the other hand, at 10kV, photographic recording of single transients at writing speeds up to 1000 km/sec is possible. In addition to the small spot size and high brightness, a blue component in the screen material makes this tube especially suitable for such applications.

Connection to the deflector plates is made by side pins in order to reduce capacities and to simplify amplifier design. Designers' problems are further eased by the high figure of 300 Mc/s for the resonant frequency of the deflector plate system.

Write to the address below for full details of the 4EP1.

Abridged Data

Screen

P1 green fluorescent medium persistence. Other screens available to order.

Capacitances

x^1 to x^{11}	1.7pF
y^1 to y^{11}	1.7pF
One x plate to all other electrodes less other x plate	4.0pF
One y plate to all other electrodes less other y plate	3.0pF

Heater

Vh=6.3V Ih=0.55A.

Typical Operation

Va1	2,000V
Va2	460 to 530V (for focus)
Va3	2,000V
Va4	4,000V
Vg	-28 to -60V
Sx	36.2V/cm
Sy	23V/cm

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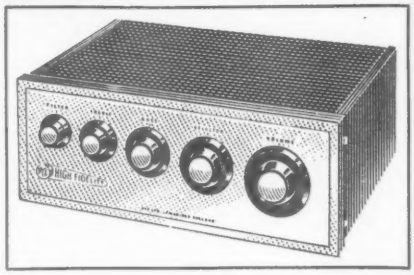

For a speaker our choice would be the Lowther Acousta cabinet and P.M.6. pressure unit at a total price of **36 gns.**

Alternatively the famous WHARFEDALE SFB/3 free standing unit at **£39/10/-.**

To complete the system a Brenell tape deck with rev. counter at **£24/12/-** and a Lowther tape preamplifier and power pack at **£30/10/-.**

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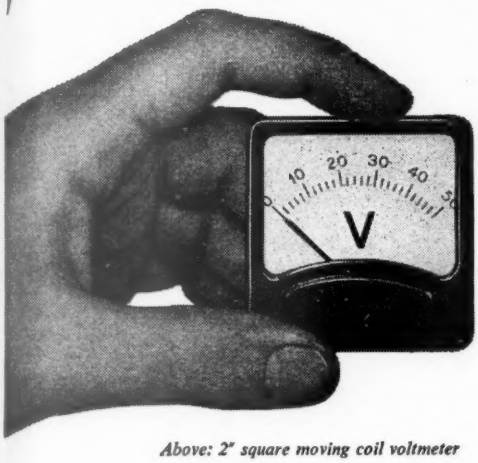

Above: 2" square moving coil voltmeter

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OSCILLATORY TEST—up to one million operations.

SPECIFICATIONS B.S. 89–1954 and other International Specifications.

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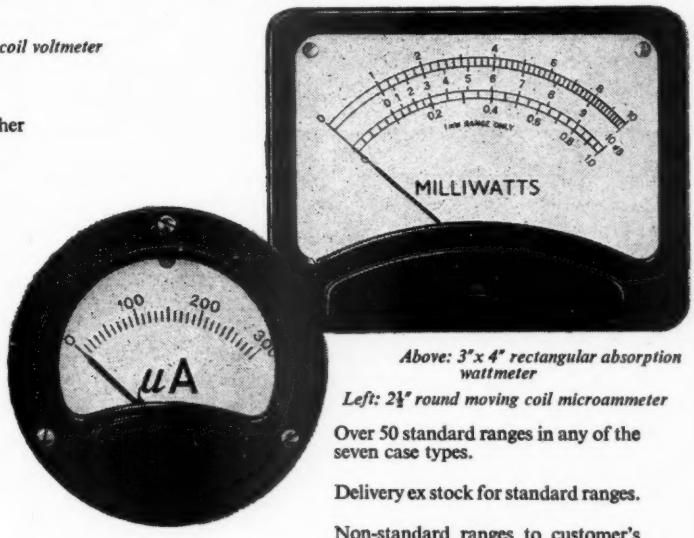
Rectifier moving coil for A.F. applications.
Thermo-couple operated moving coil for R.F. applications.

SIZES

Square: 2", 2½" and 3½" nominal scale length.
Round: 2½" and 3½" nominal scale length.
Rectangular: 5" x 6" or 3" x 4" nominal case size.

Design registrations pending.



Above: 3"x 4" rectangular absorption wattmeter

Left: 2½" round moving coil microammeter

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Delivery ex stock for standard ranges.

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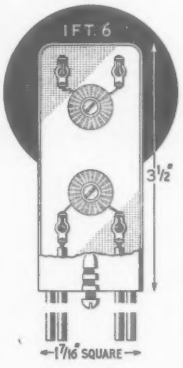

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IFT. 11/465 Kc/s and 1.6 Mc/s.

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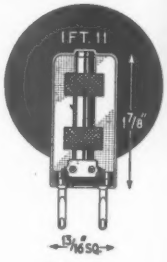
As above but with secondary tap for limiter input circuits. PRICE 6/6.



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A superior IF Transformer for use in high quality receivers and tuners. Permeability tuned, litz wound coils, high-grade iron dust cores and silver mica condensers. Termination is made by four coloured flexible leads. Coupling is optimum at 465 Kc/s and slightly sub-optimum for increased selectivity at 1.6 Mc/s. IFT. 6A has all leads brought out at the bottom while IFT. 6B has a top screened grid lead. Screening can 3½in. × 1 7/16in. square.

PRICE: TYPE 'A,' 9/-. PRICE: TYPE 'B,' 9/4.

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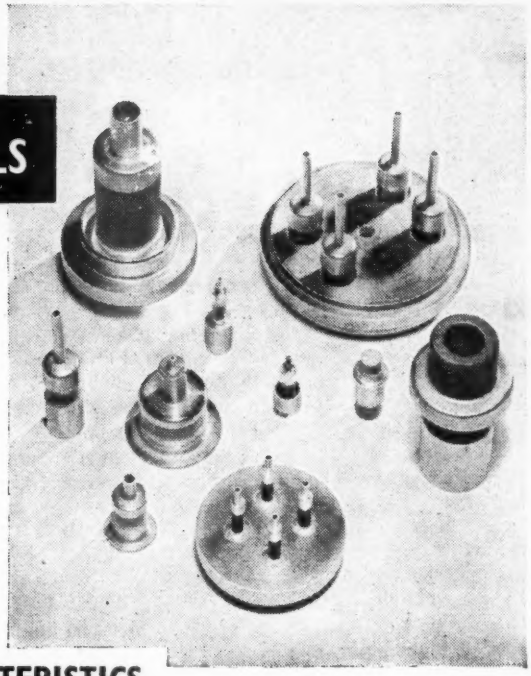

CHARACTERISTICS

Operating Temperature	intermittent 700°C maximum. continuous 300°C - 450°C dependent on atmosphere.
Operating Pressure	at least 100 atmospheres, depending on direction of compression.
Mechanical Strength	shearing force = 2,500 lbs per square inch of seal area.
Electrical Insulation	breakdown voltage in air is greater than 24 kV per inch of ceramic between seals.
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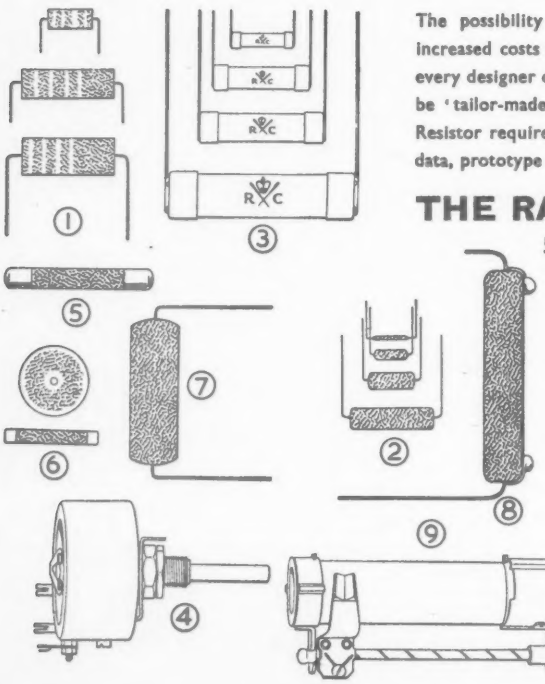

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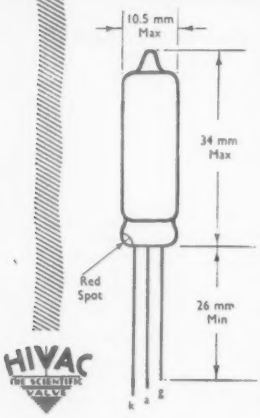

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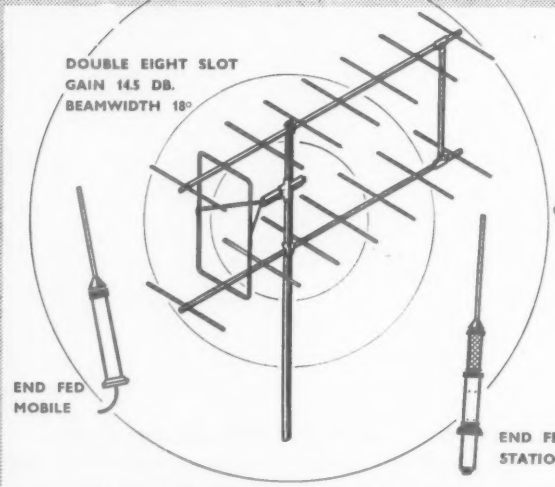

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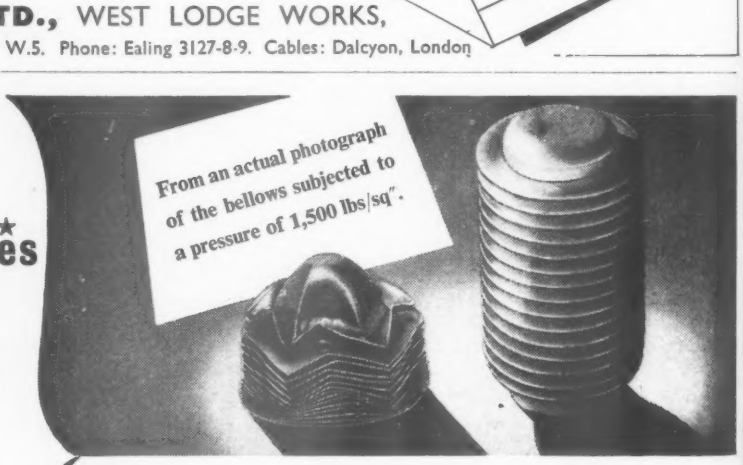

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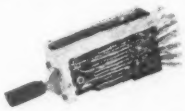

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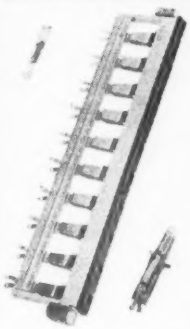

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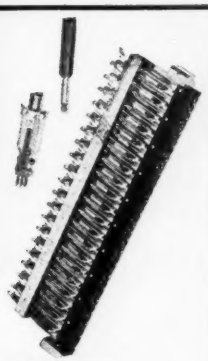

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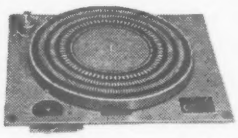

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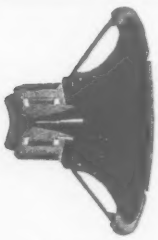

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The Tannoy Dual Concentric Loudspeaker since its introduction nearly twelve years ago has become an accepted standard of comparison amongst professional audio engineers and musicians when judging the other elements in a high-quality reproducing chain. The completely separate high frequency and low frequency unit, resulting in very low intermodulation products, excellent distribution, and smooth extended frequency response, makes this unit ideal where quality is of paramount importance regardless of price.

The G.R.F. Enclosure is designed to exploit to the full the outstanding performance of the 15" Dual Concentric Loudspeaker, it provides a compound expanding sound source, the effect of this is that the wave front area varies with frequency, giving a remarkable illusion of realism to both solo and orchestral music. In addition, the system has all the well-known advantages of horn loading, but none of the special distribution defects associated with conventional horn or multi loudspeaker systems.

SPECIFICATION

FREQUENCY RESPONSE	30-20,000 C.P.S.
POWER EFFICIENCY	10% APPROX.
BASS HORN DEVELOPMENT	EFFECTIVE DOWN TO 30 C.P.S.
SIZE	HGT. 46" DPTH. 26½" WIDTH 40"
FINISH	MAHOG. OR WALNUT
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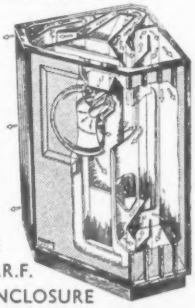

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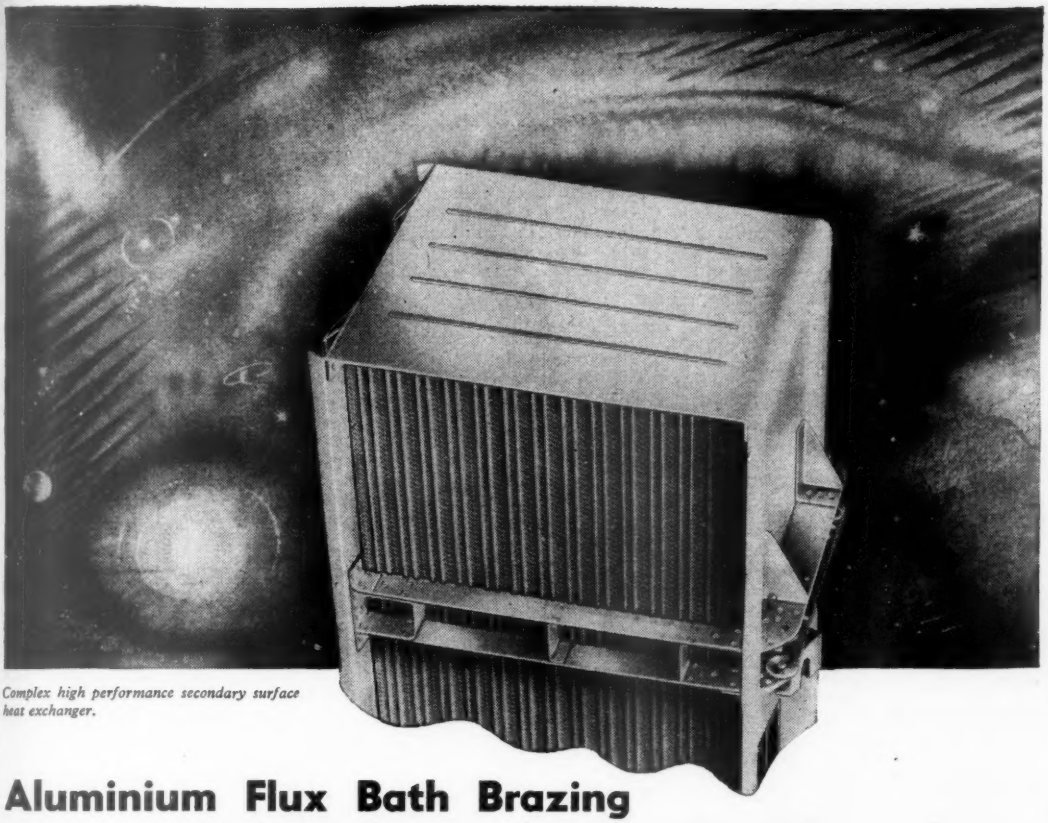

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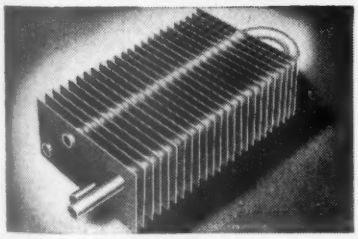

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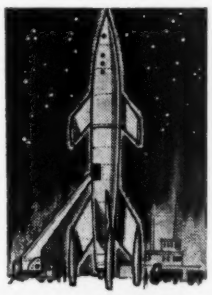
Above: Fuel cooled oil cooler for high performance gas turbine engines.

Below: Typical example of industrial heat exchanger.



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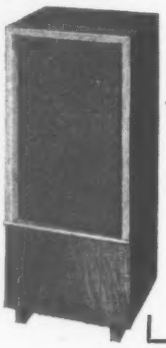

Size 24*in.* x 11*in.* x 10½*in.*

Weight 16½ *lb.*

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The AF10 Reflex Cabinet has been specially designed for the Wharfedale 10in. units with foam surround, but it can be used with any good 10in. loudspeaker having an open baffle resonance below 45 c/s.

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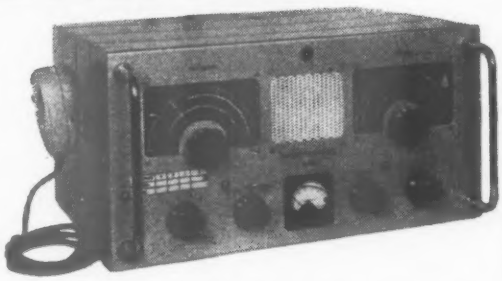

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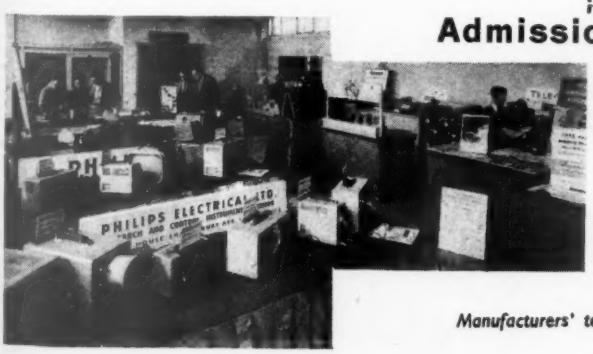

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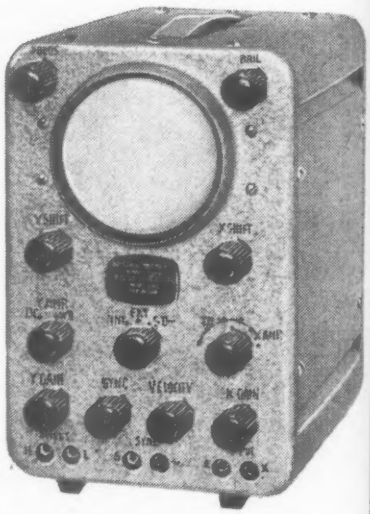

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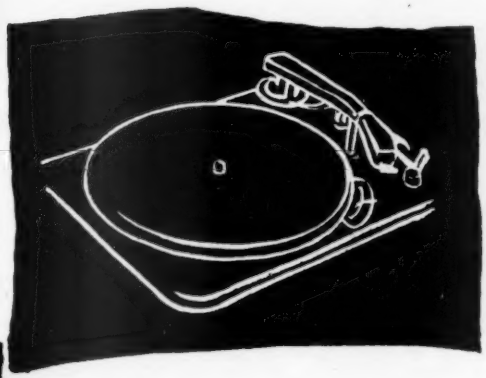

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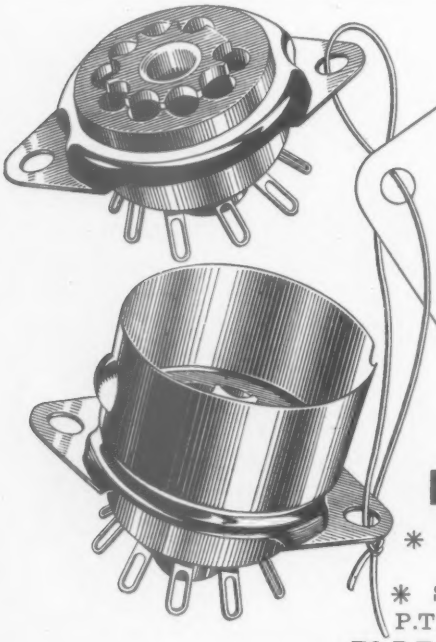

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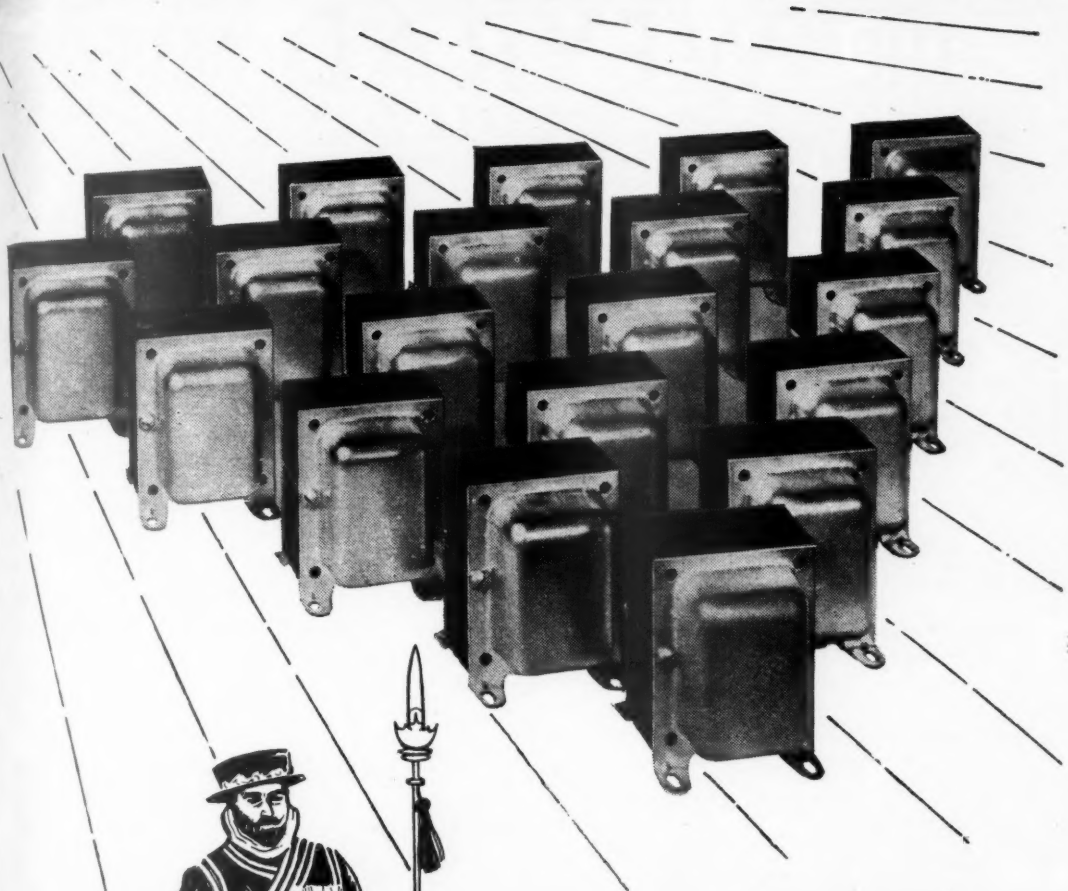

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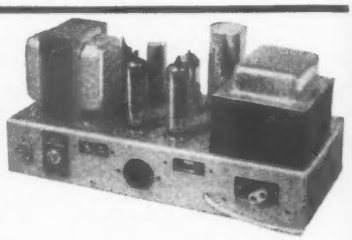

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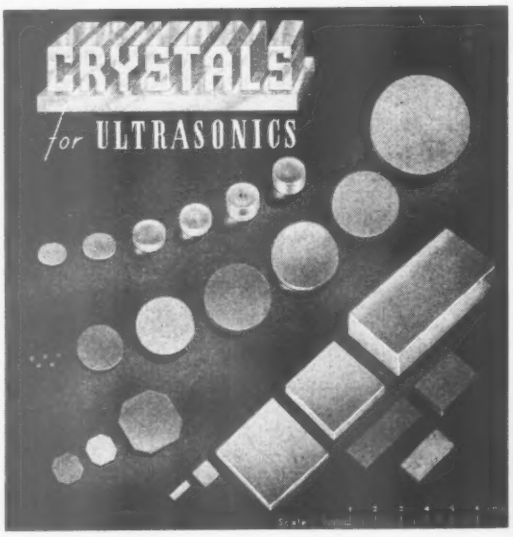

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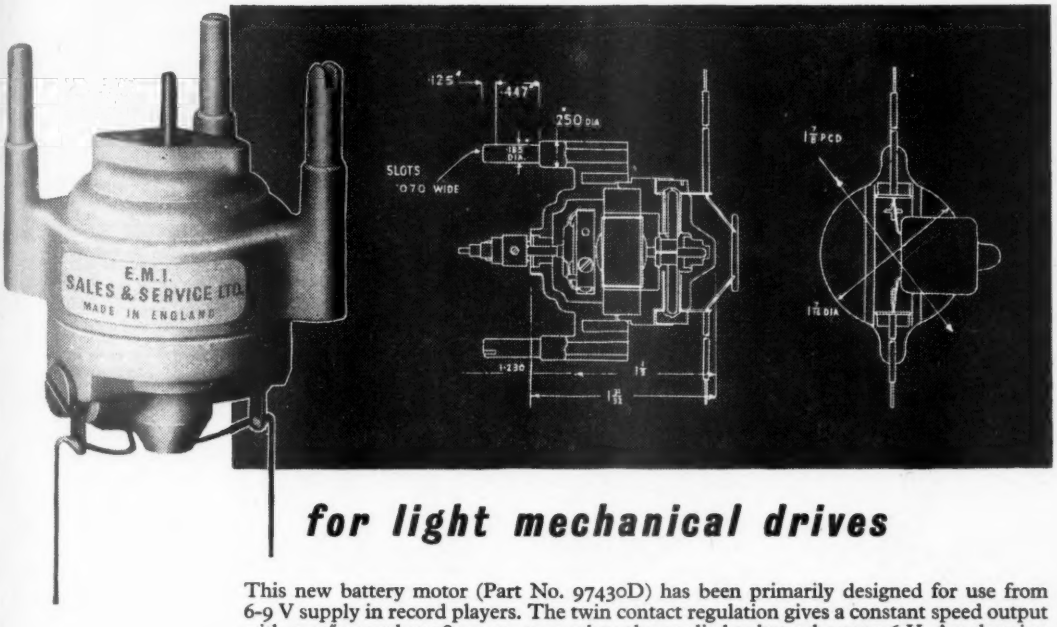
A NEW BATTERY MOTOR by E.M.I.



for light mechanical drives

This new battery motor (Part No. 97430D) has been primarily designed for use from 6-9 V supply in record players. The twin contact regulation gives a constant speed output with a 12″ record at 78 r.p.m. even when the applied voltage drops to 6 V. Acceleration time to 78 r.p.m. with a 12″ record is 1 sec. The motor will operate a 4-speed record player for over 100 hours from U2 cells.

Other applications: vending machines, fans, business machines, remote control gear and model building.

Technical Specification

SIZE $1\frac{31}{32}$″ (4.9 cm) deep (excluding spindle) $1\frac{7}{16}$″ (3.6 cm) diameter.
The motor is fitted with integral mounting legs $\frac{3}{16}$″ diameter on $1\frac{7}{8}$″ PCD for fitting through rubber grommets. A wire support can then be fixed in open slots in the legs. The motor can be supplied without legs if required.

WEIGHT 2.8 oz (80 gm).

SPINDLE 0.094″ diameter +.00025-0000″. Maximum extension 0.5″ from top bearing. Actual length to suit customer.

BEARINGS Self-lubricating bronze type with felt reservoirs for bearing at spindle end.

ROTATION Anti-clockwise.

SPEED GOVERNOR Twin contact centrifugal type. Normal speed 2600-2660 r.p.m. at 4 gm-cm torque over 9 V to 6 V DC. Can be set to other speeds between 2400 r.p.m. and 2800 r.p.m. to suit customer. Speed regulation better than 0.13% per gm-cm applied torque. Motor available without speed governor if required.

VOLTAGE 9 V maximum. Designed to operate from 6 to 9 V.

CONSUMPTION Current consumption linear with applied torque. 65 mA at free speed. 100 mA at 4 gm-cm i.e. designed working load torque. Consumption independent of applied voltage over range 6-9 V DC for constant load torque.

TORQUE Starting torque not less than 30 gm-cm at 6 V DC. Governed torque not less than 10 gm-cm at 6 V. Acceleration of 12″ record to 78 r.p.m. in 1 sec.

Our range of motors includes shaded pole induction motors, split phase motors, induction motors, designed for use in tape recording equipment, tape machines, record players, automatic record players, fans, mixers, etc.

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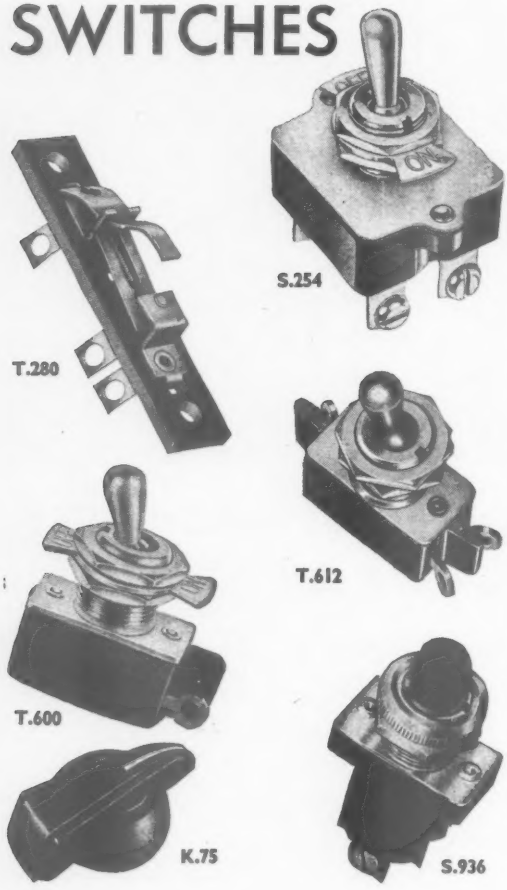

S.254: 10-amp. Double Pole Toggle Switch.
T.280: Sensitive Snap Action Switch.
T.612: 3-Terminal Single Pole Change-over.
T.600: 3-amp. Toggle Switch.
S.936: Push Switch, available normally On or Off.
K.75: Small Pointer Knob for ¼in. spindles.

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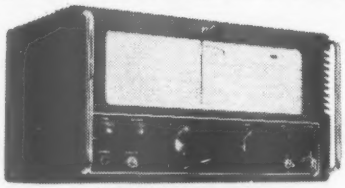

Model 840A illustrated
Cash Prices and Statutory Terms

Model	Cash Price	Deposit	8 Monthly Payments of
820	£31 18 0	£3 14 6	£3 14 6
870	£34 16 0	£4 1 6	£4 1 6
840A	£55 0 0	£6 8 4	£6 8 4
750	£78 0 0	£9 2 0	£9 2 0
888	£110 0 0	£12 16 8	£12 16 8
680X	£120 0 0	£14 0 0	£14 0 0

Cash price if paid in 6 months by Bankers' order.
Carriage paid per passenger train.

Model 840A is for A.C. or D.C. 110/250 v.; 750 and 680X 110/240 v. A.C. These sets are the choice of the discerning professional and amateur users. Descriptive literature gladly forwarded.
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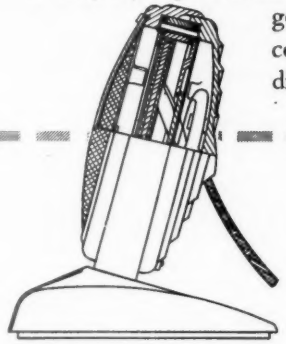
It should have a good and adequate frequency response; it should have a high sensitivity in order to achieve a high signal to noise ratio; its cost should be reasonable.

The Grundig Condenser Microphone fulfils all these requirements.

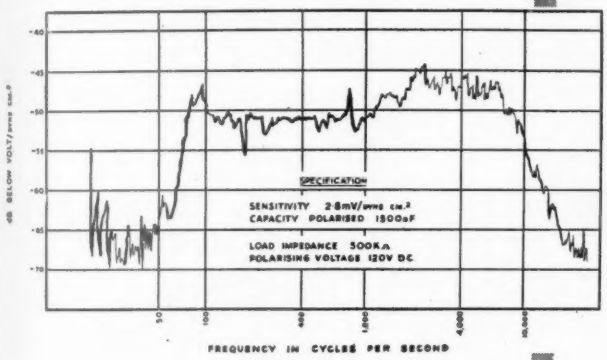
In the Grundig Condenser Microphone a plastic diaphragm, covered with pure gold is made to press against a copper plated, perforated counter electrode. Fluctuations in air pressure cause the diaphragm to be pressed into and against the edges of the perforations which result in variations of the capacity.



PART SECTIONAL VIEW OF
GRUNDIG CONDENSER MICROPHONE

A Polarising voltage of approximately 100 to 150 volts is required to operate the Microphone and provision for this is made on Grundig Recorders. The sensitivity is very high compared with other Microphones and is in the order of 2.8mV/μbar. The total capacity in its energised condition is approximately 1500pf.

The two illustrations show the internal construction of the Grundig Condenser Microphone and its frequency response.



GRUNDIG

Makers of the finest Tape Recorders in the world

GRUNDIG (Great Britain) LTD.

39/41 NEW OXFORD STREET, LONDON, W.C.1

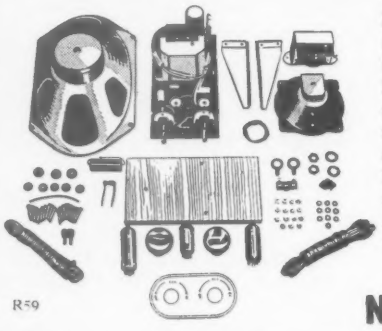
(Electronics Division, Gas Purification & Chemical Co. Ltd.)

GS110a

First of a new range of **COSSOR KITS**

AN EASY·TO·ASSEMBLE AMPLIFIER

for the "Do-it-Yourself" enthusiast



This new Cossor kit consists of a printed circuit board, two loudspeakers and all the components necessary to assemble a 3 watt high-quality amplifier. Fully illustrated easy-to-follow instruction manual included.

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TACHOMETER GENERATORS AND SERVOMOTORS

EXACTLY to BuOrd Spec

Mark 1 Mod 1 TACHOMETER GENERATOR *(Size 15)*

MUIRHEAD

Supply		115V	400c/s
Generated Voltage per 1000 rev/min			3·1V
Phase Shift at 3000 rev/min			5° lagging
Residual Voltage at 0 rev/min			
R.M.S. 0·013V	: Fundamental		0·008V
Weight		7oz	200g

Mark 12 Mod 0 SERVOMOTOR *(Motor Tachometer Size 15)*

MUIRHEAD

Supply to Phase 1 115V 400c/s
to Phase 2 115V 400c/s or 57·5V 400c/s

MOTOR PERFORMANCE

Torque at Stall (minimum)	1·45oz in	104g cm
Torque at 2500 rev/min (maximum power output)	0·8oz in	58g cm
No Load Speed (minimum)		4500 rev/min
Weight with Generator	14oz	400g

The Generator figures are the same as for Mark 1 Mod 1 above

Mark 16 Mod 0 SERVOMOTOR *(Motor Tachometer Size 18/15)*

MUIRHEAD

Supply to Phase 1 115V 400c/s
to Phase 2 115V 400c/s or 57·5V 400c/s

MOTOR PERFORMANCE

Torque at Stall (minimum)	2·35oz in	170g cm
Torque at 2500 rev/min (maximum power output)	1·5oz in	110g cm
No load speed (minimum)		4500 rev/min
Weight with Generator	19oz	540g

The Generator figures are the same as for Mark 1 Mod 1 above

Servomotors can also be supplied with various low impedance control windings. Write stating your requirements.

Data sheets giving full information on the above and a handy reference sheet on our full range of Synchros and Servomotors are available on request.

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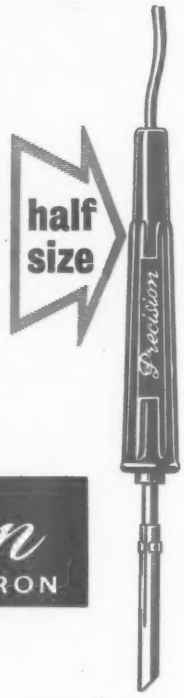
The unique construction of the 'Precision' soldering iron enables A.N.T.E.X. to offer a really small well-balanced instrument for direct operation on mains supplies, in addition to the low voltage range of 6, 12, 24 and 28V. Models are available having a consumption of 8, 12 or 15 watts, and 5 bit sizes are produced, covering from $\frac{3}{32}$" to $\frac{3}{16}$" (heavy duty).
Mains transformers are available to suit the lower voltage irons.



- Complete weight less than one ounce.
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- Non-slip handle with thermal airgap.
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(CABINETS See page 58)

RADIO CHASSIS

Empress 9-valve de luxe AM/FM with two speakers 26 gns.
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H.3 AM/FM 3 wavebands £20 17 0
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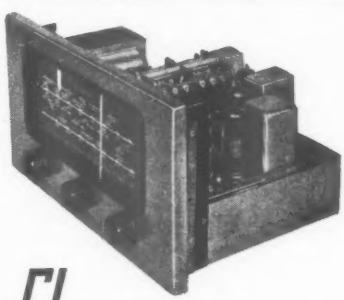

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Compact and easy to instal. This chassis is the ideal tuner for the domestic High Fidelity system. Superb FM quality and AM sensitivity combine to give excellent BBC and Continental reception.

★ **FM 85 Medium, Long plus FM with tuning eye on all bands and volume control.**

24 gns or self-powered 28 gns
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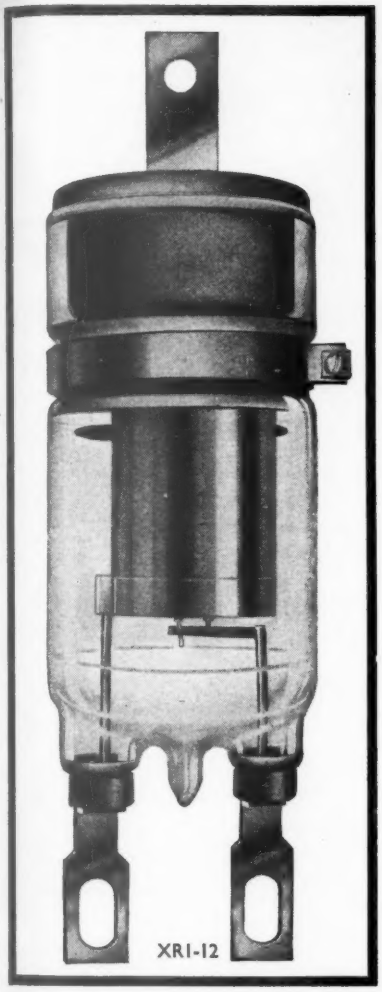

6 and 12 amp Xenon Triode Thyratrons

New Disc-Seal construction gives these positive advantages

- ✳ **High hold-off voltage**
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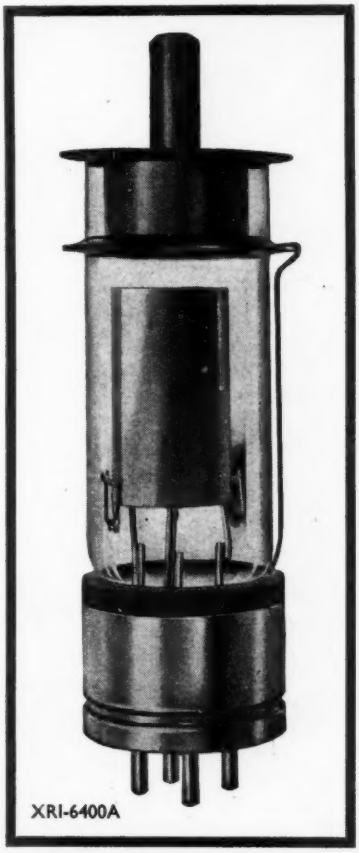

The basic advantages of Xenon thyratrons are enhanced in the Mullard XR1–6400A and XR1–12 by a new type of construction which provides improved electrical and mechanical performance.

The XR1–12 will continuously control currents of up to 12 amps, while the maximum capacity of the XR1–6400A is 6.4 amps. These two valves are rugged and their long life is backed by a year's guarantee. Their heating-up time is only one minute and they will operate efficiently over a wide range of ambient temperatures.

Both types can be employed with confidence in a variety of power control applications including direct welding control, lighting control, motor control, electronic switches and regulated power supplies. Write to the address below for full data.

Type No.	American Type No.	Vf (V)	If (A)	va (pk) max. (kV)	P.I.V. max. (kV)	ik (pk) max. (A)	ik (av.) max. (A)	Heating-up time (secs)
XR1–6400A	6807	2.5	21	1.5	1.5	80	6.4	60
XR1–12	5855	2.5	34	1.5	1.5	150	12.5	60

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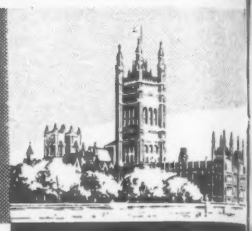
PREMIER



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MAY BE BUILT FOR **£7-7-0** plus 3/- post & packing.

Batteries extra.
HT 10/- (Type B126) or equivalent.
LT 1/6 (Type AD 35) or equivalent.

- ★ Size only 8in. x 8in. x 4½in.
- ★ Weight, including batteries, 5½lb.
- ★ 4 valves of the economy type.
- ★ Medium and long wave superhet circuit.
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- ★ High sensitivity on both wavebands
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- ★ Designed in our own laboratory.
- ★ Backed by an up-to-date Technical Information Dept.
- ★ Components available separately if desired.
- ★ Simple to construct, using normal soldering methods.
- ★ Instruction book 1/6.

SAVE POUNDS AND PUT IT TOGETHER YOURSELF!

TOTAL COST ONLY **£9-19-6** plus 5/- packing & postage.

Each Unit may be purchased separately as follows:—

Amplifier Cabinet in maroon and fawn (size 13¾ × 11 × 6½in.)	£2/10/-
1 Valve Amplifier	£2/19/6
7 × 4in. Elliptical Speaker	£1/1/6
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This can also be supplied complete with the **Latest Collaro 4-speed Junior Turntable and Pickup** for only £10/12/6 plus 5/- packing and postage.

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2-BAND TRF RECEIVER MAY BE BUILT FOR £5.10.0

plus pkg. & post 3/-

3-BAND SUPERHET RECEIVER

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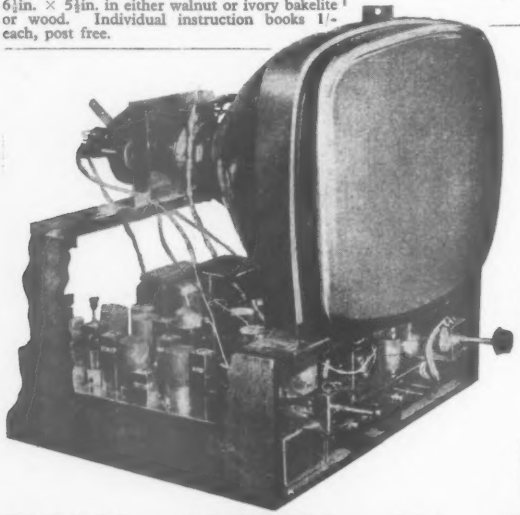
These two receivers use the latest type circuitry and are fitted into attractive cabinets 12in. × 6½in. × 5½in. in either walnut or ivory bakelite or wood. Individual instruction books 1/- each, post free.

PREMIER BATTERY ELIMINATOR

Housed in two containers which are exactly the same size as AD35 & B126 Batteries.

KIT **37/6** Plus 2/- post & packing.



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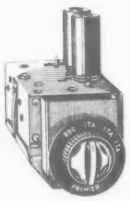
which gives complete SAFETY to the constructor!



These Televisors use a double wound mains transformer which gives you complete safety from contact with the mains supply when handling the chassis or controls.

★ B.B.C. & I.T.A. DESIGN

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CONSOLE CABINETS with full length doors for 14in., 16in. and 17in. tubes. PRICE £14/14/-. H.P. Terms: Deposit £7/7/6 and 9 monthly payments of 18/6. **CONSOLE CABINETS.** Half-door £12/12/-. H.P. Terms: Deposit £6/6/- and 8 monthly payments of 18/3. On above cabinets add 21/- for pkg. and carr.

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for only

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This Kit comprises:

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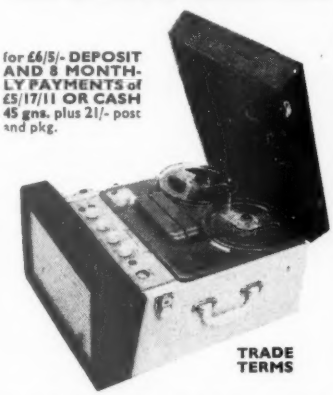
Latest Type ACOS microphone	£2/15/-

All the above sections can be purchased separately.

The New De-Luxe

TAPE RECORDER TR3

for £6/5/- DEPOSIT AND 8 MONTHLY PAYMENTS of £5/17/11 OR CASH 45 gns. plus 21/- post and pkg.



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Case finished in Red and Cream with Gilt styling and fittings. Size 18½ × 15 × 9in. For A.C. mains 200/250 v. 50 cycles. Complete with tape and latest Acos microphone 2-speed twin track giving 1 or 2 hours recording respectively, incorporating a 10 × 6in. high flux loudspeaker.

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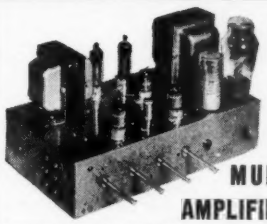
WEARITE 3A Decks	£35/0/0
3B Decks	£40/0/0
COLLARO Decks	£22/0/0

Packing and Carr. 10/- extra on all three items.



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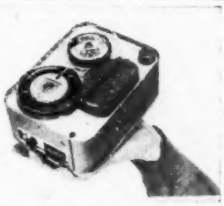
All the components for model 510, PLUS pre-amplifier, on one chassis (total six valves), chassis gold hammer finished. May be purchased for £12/12/- plus pkg. and post 7/6. This version complete and tested £15/15/-. Or pre-amplifier and tone control in a separate unit £14/14/- plus pkg. and post 7/6.



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BATTERY TRANSISTOR MINIATURE

TAPE RECORDER

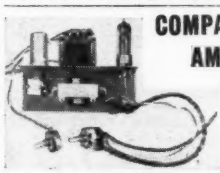
Supplied complete with Microphone and small Loudspeaker, operates on 4 U2 Torch batteries, weighs only 4 lb. and plays for 30 minutes Size 6½ × 4½ × 3½in. **26 gns.** complete plus 5/- Retail Price pkg. and post. OR on Credit Terms: Deposit £3/8/- and 8 monthly repayments of £3/10/-.

THE JASON "ARGONAUT"

MW/FM DESIGN

★ **All Premier components are designer approved**

ALL components to build the complete Receiver, including output stage, may be purchased for £15/5/-, or all components less output stage but including Power Supply, for £13/19/6, plus packing and postage 3/6 on each.



COMPACT GRAM AMPLIFIER

Complete ready to connect to any type of Pick-up and Speaker (3 ohms) A.C. Mains 200/250 v. Volume and tone control on 9in. extended leads, 1 valve. Overall size 7in. long × 6in. wide × 3½in. high. Suitable speaker for above 7in. × 4in. elliptical **21/10.**

Price **£2.19.6**

Plus pkg. & post 2/6.

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MODEL PC/S

Grey Lizard Rexine covered 45/-

Overall dimensions 15in. × 13½in. × 6½in. Clearance under lid when closed 3in.

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Two colours, wine and grey, with cut-out for speaker and amplifier 55/6

Dimensions 15in. × 14in. × 7½in.

MODEL PC/3

Grey Lizard Rexine covered 69/6

Overall dimensions 16½in. × 14½in. × 11in. Clearance under lid when closed 3½in.

MODEL PC/3 DE LUXE

As above but with cutouts for Speaker and Amplifier 79/6

Dimensions as above.

THE ABOVE CABINETS ARE COMPLETE WITH CARRYING HANDLE, FASTENERS AND PANEL.

Packing and Postage 3/- each.

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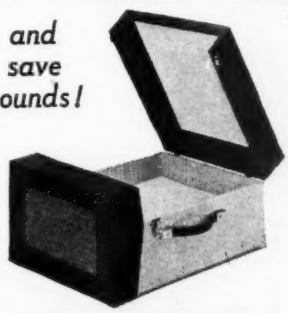
LORENZ MODEL PL 562

4-speed gram. motor.

Price **£3 . 13 . 6**

PUT IT TOGETHER YOURSELF

and save pounds!



Cabinet £2/19/6, plus 5/- *pkg. and post.*

Premier 1 valve Gram. Amplifier £2/19/6, plus 2/6 *pkg. and post.*

Premier 2 Valve Printed Circuit Amplifier £3/5/6, *plus* 2/6 *pkg. and post.*

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Collaro 4-Speed Changer £8/19/6, *plus* 5/- *pkg. and post.*

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If a set of parts is purchased together pkg. and post will be 10/-.

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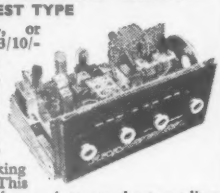
AM/FM RADIOGRAM CHASSIS
OF THE LATEST TYPE



Cash £22/10/-, or Credit Terms £3/10/- Deposit and 8 monthly payments of £2/14/8. H.P. Terms £11/5/- Deposit and 12 monthly payments of £1/0/11. Packing and carr. 7/6. This chassis has 8 valves and covers short, medium and long FM and Gram. Printed circuit on FM ensures a high degree of stability. Overall size 14in. long, 6½in. high, 9in. deep. Dial size 12 × 5¼in.

MERCURY SWITCHED FM TUNER *by* JASON

5 valves Foster-Seeley Discriminator
Complete set of parts can be purchased for £9.19.6 plus2/6 p.p.
All the components can be purchased separately. The main components are as follows:—

Chassis	6/6
2 side panels, pair	3/-
Prefabricated front-end completely wired and tested with IEF80 and IECF80 (incl. P.T.)	£6/5/-
Discriminator	11/6
2 I.F. Transformers at 5/9 each	11/6
Complete instruction book	2/-

COLLARO R.C.456
4-SPEED AUTOCHANGER

Designed to play 12in., 10in. and 7in. Records intermixed in any order at 16, 33⅓, 45 or 78 r.p.m. Capacity 10 records. New reversible Dual Stylus Crystal Pick-up for use on 100/250 v. 50 cycle A.C. mains £8/19/6
Plus packing and postage 5/-.

PREMIER BUREAU DE LUXE

A superb cabinet in finely figured walnut veneer. Interior light sycamore with rexine matching lining. Overall dimensions: 33in. high, 34in. long, 17½in. deep. Uncut control panel on right-hand side approximately 16in. × 10½in., uncut baseboard on left-hand side 15½in. long, 13½in. deep. Two full size felt-lined storage cupboards in the lower part of the cabinet.
Cash price ..... 16½ gns.
Credit Terms: Deposit £2/6/6 and 8 monthly payments of £2/3/2. Packing and carriage 25/- extra.

The Latest COLLARO 4-speed single player £4/12/6
Plus 2/6 packing and carriage.

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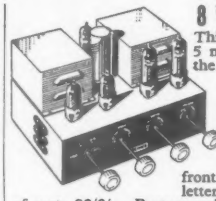

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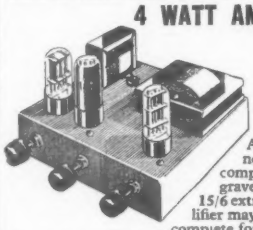

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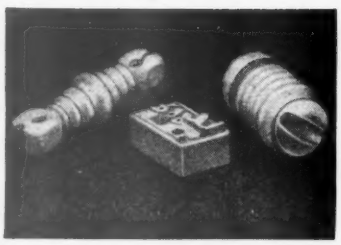

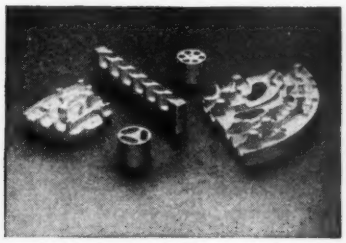

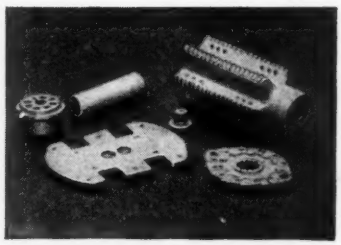

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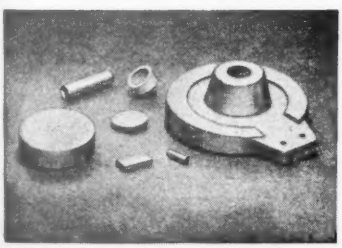

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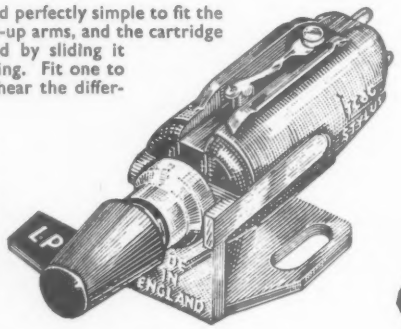

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Wireless World

ELECTRONICS, RADIO, TELEVISION

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MAY 1958

In This Issue

203 Editorial Comment
204 Asymmetry in Long-distance W/T Circuits — *By A. M. Humby*
208 Fourth International Instrument Exhibition
210 Radio Navigational Aids
212 Flip-Flop Stability — *By T. G. Clark*
214 World of Wireless
216 Personalities
218 News from the Industry
219 Physical Society's Exhibition
225 Letters to the Editor
227 Conductors and Insulators — *By "Cathode Ray"*
231 Transistor Television Circuits—2 — *By J. N. Barry and G. W. Secker*
235 Sensitive Tuning Indicators — *By Richard Oliver*
237 Direct-coupled Transistor Audio Amplifier — *By D. A. G. Tait*
239 Technical Notebook
241 Transistor Transmitter — *By L. F. Shaw*
244 Television Reception on Band V — *By H. N. Gant*
246 May Meetings
247 "New Tubes for Old"
249 Exhibitions and Conferences
250 Random Radiations — *By "Diallist"*
252 Unbiased — *By "Free Grid"*

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Vol. 64 No. 5

Wireless World

The Status of Electronics

EVER since the term electronics was admitted by common usage to the language attempts have been made to define and circumscribe it—with conspicuous lack of success.

The early American definition as "that branch of science and technology which relates to the conduction of electricity through gases or in vacuo" is now generally acknowledged to have been proved abortive by the advent of the transistor and other semiconductor devices which have resulted from advances in our knowledge of solid state physics. The photojunction transistor is as much a part of "electronics" as the photo-electric cell.

When the Institution of Electronics was incorporated in 1935 the "science of electronics" was referred to as "the study of the electron at rest or in motion, and other kindred subjects"—a definition which is broad enough to have stood the test of time, but is inadequate as a description of electronics as it is tacitly accepted to-day. The only kindred subject specifically mentioned in the memorandum of association of this body is "radio science," and this reflects the view long held by this journal that electronics started as the application of radio-like devices and methods in fields other than those of communication. This view is no doubt shared by the British Institution of Radio Engineers, which devotes a considerable proportion of its time to electronic matters. The Institution of Electrical Engineers cuts the Gordian knot by proclaiming both radio communication and electronics as examples of light-current electrical engineering, and adds considerably to its stature and membership by catering for both. The Institute of Physics recognizes at least one course in the physics and technology of electronics as leading to qualification for graduate membership.

But there are indications that electronics may not be so easily confined within the older technological disciplines. For instance, one sees many advertisements of appointments and situations vacant for electronic(s) engineers; almost as many as for electrical engineers. Even more significant are the advertisements of some of the larger firms, particularly those in the aircraft industry, which invite applications for both these types of post. Presumably the hard-headed business men who pay for these advertisements know what they want, and have good reasons for making a distinction.

Then again there was the shock to our own *amour propre* when we read in a recent book the chapter heading "Electronics in Communication"—the tail wagging the dog with a vengeance!

Which brings us to the point, which we have so far evaded, of saying what we mean by electronics and what entitles a man to call himself an electronics engineer. Any precise definition must be doomed to be as short-lived as a police description of a growing youth, so we will content ourselves with the figurative and say that electronics is a bag of tricks culled from radio, radar and electrical engineering, to which are added from time to time any likely new items from research in pure and applied physics. An electronics engineer is a man who knows instinctively what to pop into the bag for future use, and what to pull out for any given occasion.

One of the most useful assortment of oddments came from wartime radar activities, and with them came that attitude of mind which was unabashed by seemingly insuperable difficulties. There is not one but a hundred "electronics", and as many varieties of "electronics engineers". The good electronics engineer is one who is always willing to shift his ground. While readily acknowledging his debt to the older sciences and technologies, he does not feel himself bound by the rules of any one discipline. He is, in fact, a sort of stateless person, a citizen of the world, who can adapt himself to any industry that has the wit to appreciate his qualities and the courage to give him a free hand.

As to his qualifications, he can be safely left to choose for himself, from the wide range offered, those which he feels will best reflect his own particular bias, or which he thinks will carry most weight with his potential employers.

Asymmetry in Long-distance

IT is not uncommon to find that there is a pronounced seasonal asymmetry in performance on certain long-distance radiotelegraph circuits even when the transmitting and receiving equipment at the terminal stations is substantially identical.

Knowledge of such phenomena is of importance in regard to: (*a*) the general understanding of the factors which determine the proportion of time for which a circuit is of commercial grade; (*b*) the assessment of the performance of new equipment introduced in one direction of a circuit when based on a comparison with the performance in the other direction, in which the terminal conditions have remained unchanged; (*c*) the choice of radio relay sites required to ensure maximum efficiency of communications under peak traffic loading.

In two recent studies [1, 2] of the performance of circuits operating from London to South Africa, Ceylon, Malaya and Australia (short route), seasonal asymmetry in performance has been explained in terms of atmospheric interference. In particular, reference has been made to the decrease in the signal/noise ratio for transmission in one direction which can occur when a distant thunderstorm area, lying in the direction of the main beam of the receiving aerial, reaches its diurnal activity maximum.

The principal thunderstorm areas are known to be associated with tropical or semi-tropical, land masses; and it is to be expected, therefore, that the performance of trans-equatorial circuits, like those mentioned, should be affected by atmospheric noise originating in such areas, particularly at a time of day and season when activity is at a maximum, i.e., during afternoon and early evening of local summer.

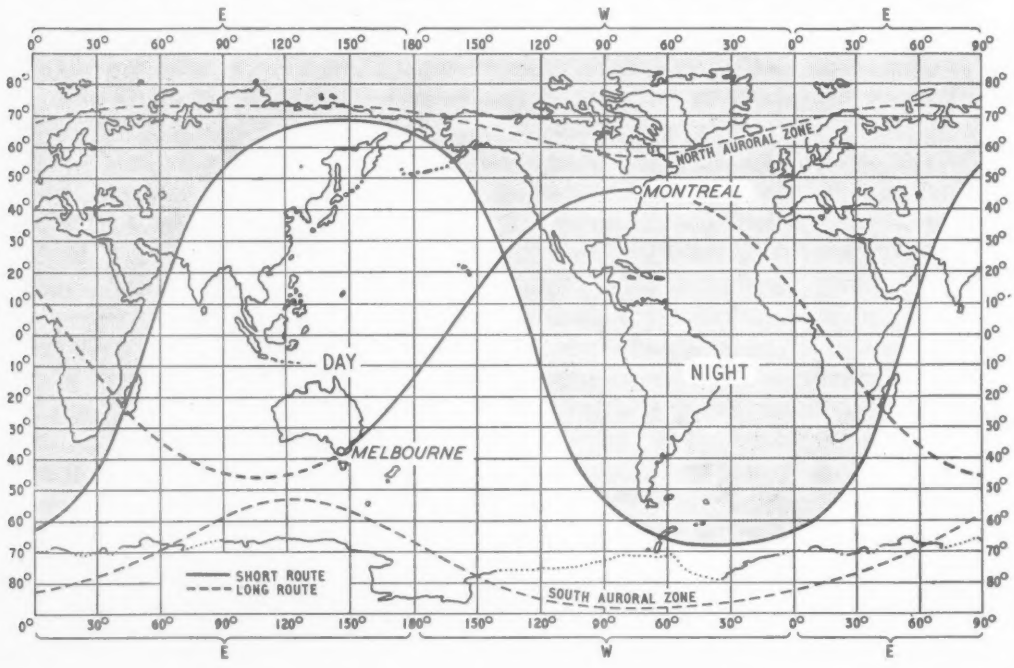
The main purpose of the present article is to examine the performance of trans-equatorial circuits which (in contrast to those previously reported on) are mainly over sea, convenient examples, being those from Montreal to Melbourne (short and long paths). Between these two terminals the short route is over sea in the proportion of 72%, and the long route over sea in the proportion of 64%. The analysis covers the 21-year period 1935 to 1955 inclusive, and the performance data is derived from reports prepared hourly by the operating personnel.

Montreal-Melbourne Circuit Characteristics.—*Use of Short and Long Routes.*—Due to the contrasting conditions of daylight and season associated with this route, the proportion of time for which frequencies in either the upper or lower part of the h.f. spectrum can be successfully used is small, and in consequence extensive use has to be made of intermediate frequencies, for example, those between 9 and 13Mc/s.

Even on such frequencies, however, absorption of the signal under conditions of excessive daylight along the path may be such as seriously to limit the speed of telegraph operation, despite the use of first-class equipment.

Thus difficulties in communication arise in December at about 0230G.M.T., i.e., local noon at Melbourne (see Fig. 1), and in June at about 1700G.M.T.,

Fig. 1 Alternative path conditions between Montreal and Melbourne at 0230G.M.T. (noon, Melbourne) during December.



W/T Circuits

By A. M. HUMBY*, M.I.E.E.

Seasonal Variations in Performance on Trans-equatorial Paths Mainly Over Sea

i.e., local noon at Montreal (see Fig. 2), since the amount of daylight encountered is extensive irrespective of whether transmission is directed over the short or long route. The diurnal variation of absorption for the short and long routes for the months of December and June is shown in Figs. 3(a) and 3(b) respectively, from which it will be seen that absorption can be restricted to a minimum by the use of the short route from approximately 0300 to 1630G.M.T., and the long route from approximately 1630 to 0300G.M.T. The above periods conform very closely to the average periods for which each route is in fact used in practice; the actual time of change of route on any particular day is, of necessity, dependent to a large extent on the immediate signal/noise ratio.

Diurnal and Seasonal Changes in Performance.—The diurnal and seasonal performance is shown in Figs. 4(a) and 4(b), from which it will be seen that serious difficulties arose around 0300G.M.T. in December, January and February, and around 1700 G.M.T. in June, July and August. Among other factors contributory to difficulty of communication are the relatively low ionic densities encountered at each terminal of the circuit around local sunrise, necessitating the use of lower frequencies with consequent higher absorption effects. Such periods are approximately as follows:—

Montreal Terminal, 1230G.M.T. December
0900G.M.T. June.
Melbourne Terminal, 1900G.M.T. December.
2130G.M.T. June.

See Figs. 4(a) and 4(b).

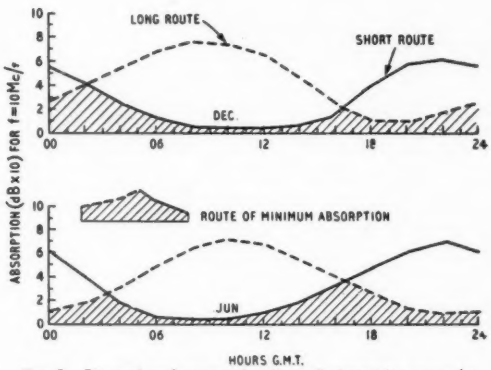
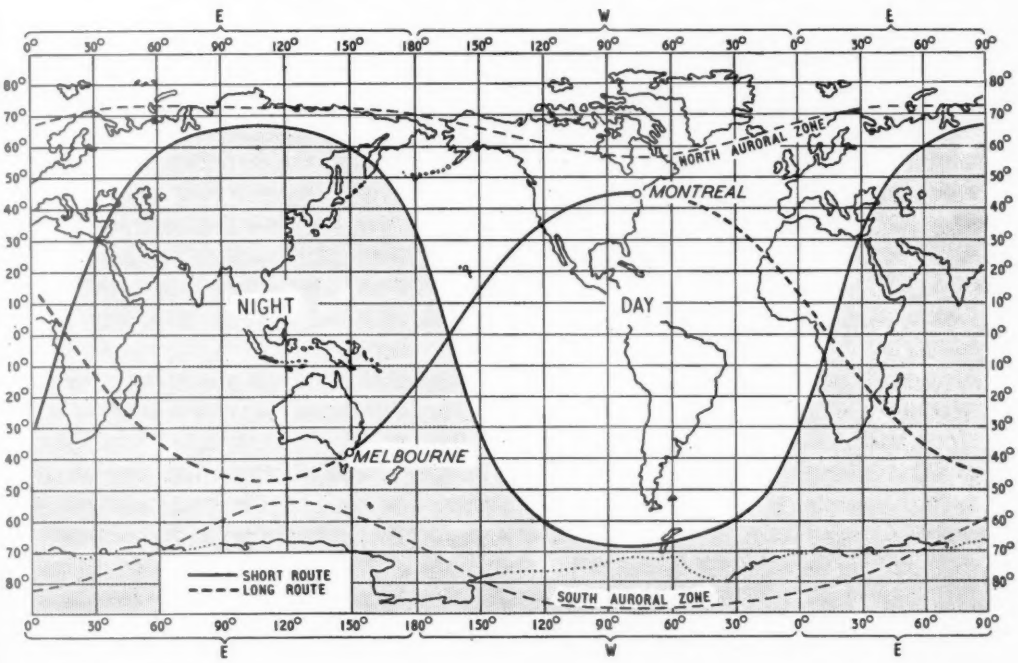


Fig. 3 Diurnal and seasonal values of absorption over the Montreal-Melbourne path.

* Royal Naval Scientific Service.

Fig. 2 Alternative path conditions between Montreal and Melbourne at 1700G.M.T. (noon, Montreal) during June.



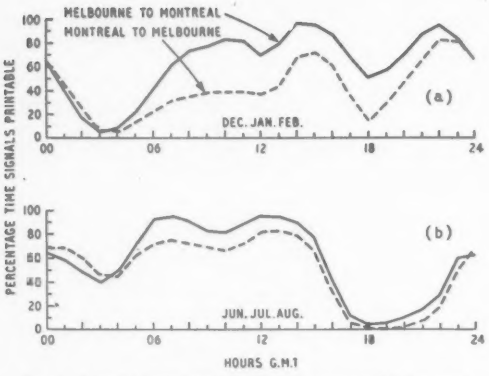


Fig. 4 Diurnal variations in performance over the Montreal-Melbourne path during 1941 to 1955 inclusive.

Asymmetry of Circuit Performance.—*Seasonal Effects.*—The seasonal changes in performance of the Montreal-Melbourne circuit for the period 1935-53 inclusive are shown in Fig. 5, from which it is clear that there is a marked deterioration in the reception of the Melbourne signals at Montreal in the months of June, July and August and a corresponding deterioration in the reception of the Montreal signals at Melbourne in the months of December, January and February.

This deterioration in circuit performance for the direction in which reception is taking place in local summer is in conformity with the local seasonal changes in thunderstorm activity. It is evident from Fig. 4, however, that unlike trans-equatorial circuits mainly over land [1, 2] (see Fig. 6) there is no sharply defined period of the day when such deterioration sets in. Thus there is here confirmation that for paths mainly over sea the absence of any sharply defined period of the deterioration during the day is associated with an absence of active thunderstorms in the direction of the main lobe of the receiving aerial.

In making this interpretation of the data, it may be desirable for the reader to note that the only case where the receiving aerial is pointing landwards is that at Montreal when use is made of the short route to Melbourne. As stated previously, the period concerned is from approximately 0300 to 1630 G.M.T., or late night to forenoon at Montreal, i.e., a period during which not much thunderstorm activity is expected in that region.

Conclusions.—A study has been made of the performance, over a 20-year period, of a Montreal-Melbourne high-frequency radiotelegraph circuit, both the short and long routes of which are predominantly over sea. In so far as the performance of these two routes may be typical of that of other long-distance trans-equatorial radiotelegraph circuits, the routes of which are substantially over *sea*, it may be concluded that such circuits are:—(*a*) subject to a seasonal asymmetry of performance, resulting in a significant fall in the performance in the direction which entails reception in local summer; but (*b*) exhibit no sharply defined hour of onset of such asymmetry, as has been reported for trans-equatorial *land* routes when the main lobe of the receiving aerial is "looking into" an area of land in which atmospherics are generated, and at a time of day when the source of atmospherics (thunderstorms) is most active..

Note.—Asymmetry of circuit performance for both land and sea routes has been less marked during the recent exceptionally high degree of solar activity. One reason for this may be the ability economically to obtain improved aerial polar diagrams at the higher frequencies necessitated by ionospheric considerations. Thus the old-time radio operator's

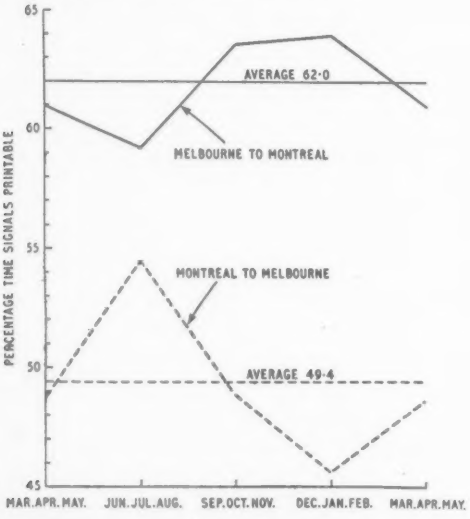


Fig. 5 Seasonal variations in performance over the Montreal-Melbourne path during 1935 to 1953 inclusive.

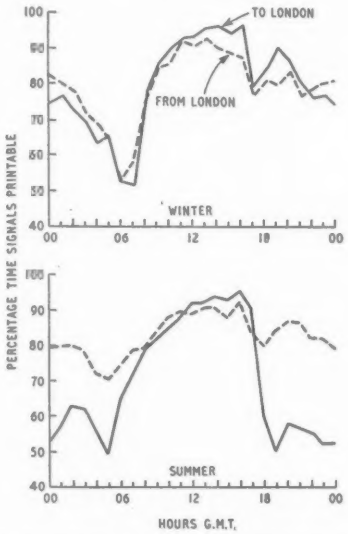


Fig. 6 Diurnal variations in performance of the Capetown-London path during 1951 to 1954 inclusive. (Reproduced from Proc. I.E.E. July 1956 Part B.)

simple rule that, "if I can hear him, he can hear me" may be more applicable to years of high, than of low, solar activity[3].

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B.B.C.'s VIDEO MAGNETIC TAPE RECORDER

STANDARD grade ½-inch magnetic tape running at 200 inches per second is used in the B.B.C.'s new Vision Electronic Recording Apparatus (called "VERA") which television viewers have recently seen in operation. The method of recording is the straightforward longitudinal one, and 15 minutes of programme can be accommodated in a 20½-inch spool of tape. A complete video recording channel consists of two of the machines controlled from a central desk.

Actually the method of recording is not quite straightforward, in that the incoming 3-Mc/s video signal is split into two frequency bands of 0-100kc/s and 100kc/s-3Mc/s, which are recorded in separate tracks. The high-frequency band is recorded directly, but the low band is used to frequency modulate a 1-Mc/s carrier signal, and it is the frequency deviations of this signal which are carried in the other track. The modulation is only in one direction, so that 1Mc/s corresponds to minimum video amplitude at the bottom of the sync waveform and 400kc/s to peak white.

This f.m. carrier system has been adopted mainly to avoid the effects of tape imperfections and spurious amplitude modulation, which experience has shown to be more noticeable in the low-frequency components of the television picture (for example, as fluctuations in large-area brightness). It also avoids the fall-off in low-frequency response which occurs during playback as a result of the slower rate-of-change of flux at low frequencies and the increase of wavelength at the high tape speed. A limiter is used in the f.m. channel just as in f.m. receiving technique. Unwanted amplitude variations also occur in the 100kc/s-3Mc/s video band but these do not noticeably degrade the picture.

The television sound signal is recorded in a third track, and the opportunity has been taken of again using an f.m. carrier system, which simplifies the problem of recording and reproducing the low frequencies at the high tape speed.

Extreme precautions have been taken to maintain constant tape speed past the recording and reproducing heads, since very small fluctuations can cause noticeable horizontal displacements in the reproduced picture similar to line tearing. The initial tape drive is on the spools themselves, with automatic adjustment for the amount of tape they carry. The final drive is from a capstan which operates inside a loop of tape, providing drive for both oppositely moving sides of the loop at once. This system effectively isolates the tape loop from speed fluctations in the spool drive. During recording the capstan drive is synchronized with the 50-c/s mains. On playback its speed is controlled by a servo system which compares the reproduced sync pulses with the station sync pulses and applies appropriate correction signals. A tape speed accuracy of 0.04 per cent is said to be obtained.

The three-channel recording and reproducing heads, which are independent and situated in the tape loop mentioned above, use ferrite cores for efficient operation at the high frequencies. They are surfaced with Mumetal where the tape passes over them and have gap widths of the order of 2×10^{-5} inch. The gap width, of course, in conjunction with the tape speed, is the thing which determines the maximum resolution of the recording system. In terms of frequency response, the equipment is flat to 2Mc/s and falls 3dB at 2.5Mc/s.

For marking editing points on the tape a 30-kc/s burst of signal is switched on to the sound track. This becomes audible on playing back at slow speed.

One of the two machines in a complete video recording channel.

Fourth International Instrument Show

EXHIBITS BY SEVENTY FIRMS FROM TEN COUNTRIES

THIS year's London exhibition, organized by B. & K. Laboratories, Ltd., was substantially larger than last year's. The report must again be confined to apparatus not previously shown; and the nationality of the makers, where not stated, is American.

As in the Physical Society's Exhibition, held concurrently, much of the equipment was intended for applications outside the scope of this journal, but it goes without saying that nowadays many of the techniques are common to all scientific and industrial fields.

Beginning with real "wireless," however, there was a demonstration of the Racal (U.K.) RA.17 communications receiver described in detail in the August 1957 issue. It will be remembered that by virtue of an ingenious tuning system a crystal-controlled frequency range of 0.5 to 30 Mc/s is covered continuously without band switching.

Interference-measuring sets designed by the Post Office, enabling tests to be made in accordance with British Standards, are offered by Union Radio (U.K.). Set No. 1, covering 150 to 400 kc/s and 0.55 to 30 Mc/s, is now supplemented by No. 2 covering 30 to 220 Mc/s, in which piston attenuators are used.

A.f. equipment included a wow meter by Furst Electronics, consisting essentially of an electronic frequency meter. Working from a constant-frequency signal recorded on the appropriate medium, it accepts any amplitude from 0.1 to 250 V and gives direct readings of wow in three ranges: 0.2%, 0.5% and 2% full-scale.

The Peekel (Holland) Type 013.V a.f. RC oscillator is unusual in covering frequencies from 18 kc/s down to 0.14 c/s, in 10 ranges. Both sine and square waveforms, and the choice of balanced or unbalanced output, are provided. The Type 10.V Function Generator (10 c/s to 100 kc/s) uses a back-coupled Schmitt circuit to generate square waves and (by integration) accurate triangular waves. The same firm showed an interesting portable Sound Spectrum Meter, reading sound or vibration levels either flat over the a.f. band or in eight octave bands.

Bruel & Kjaer (Denmark) again showed a very wide range of equipment for determining a.f. characteristics, much of it automatically operated. New instruments included Microphone Amplifier Type 2603, incorporating a number of standard weighting networks for sound level measurements. It was demonstrated as part of a vibration-test set-up A feature is that peak, mean and true r.m.s. values can be read. Roughness Meter Type 6100 was demonstrated measuring the roughness of machined surfaces. A stylus is moved over the surface at constant speed and the irregularity is indicated directly in μmetres and μinches.

To the Advance Electronics phase detector shown last year is now added "Vectorlyzer" Type 202, a useful instrument for measuring vector relations of alternating voltages over the wide range 8 c/s to 500 Mc/s. An accuracy of better than 0.05° is claimed. Besides phase angles, impedances can be measured.

Danbridge (Denmark) showed a 1 kc/s universal bridge, and a pocket-size capacitor tester with a range of 0 to 0.01 μF. This tester works on the tuned-circuit principle in the 0.3 to 1.0 Mc/s range, and enables capacitances to be read *in situ* even when shunted by low resistances.

How far the tendency for digital displays to supersede pointer indication is now going is shown when even a valve voltmeter is included—Kay Electric Model 615. Twelve ranges of direct and alternating voltage and resistance are provided, and the readings are displayed in bold figures, with illuminated decimal point.

Microwave equipment was again very much to the fore. The comprehensive Sivers (Sweden) range of equipment has been extended to include a number of hand and motor operated waveguide switches, for frequencies from 2.6 to 18 kMc/s. Fast action, low voltage standing-wave ratio, and variety of circuit arrangement are notable features. For v.s.w.r. measurements, either manual or automatic, Indicating Amplifier Type SL.5400/3 has been introduced. The ratio is directly and continually shown on the meter.

R.C.A. showed their R.F. Power Meter Type LP-91, consisting of a r.f. power bridge and set of calibrated accessories for frequencies from 1 to 10 kMc/s. It is direct reading over the power range 5 μW to 5 W within 5%.

One of the most useful facilities, especially at microwave frequencies, is a swept-frequency signal generator or "wobbulator." The new Polarad Model ESG is an impressive instrument in this field, covering the wide frequency range of 1 to 15 kMc/s in seven octave bands by means of plug-in units. The electronic frequency deviation is adjustable up to the full width of the unit in use. Maximum signal power available is substantial—up to nearly a watt at the low-frequency end. Frequency, deviation and power are all indicated directly by meters. The oscillator valve is of the backward-wave or carcinotron type.

Some fine examples of microwave "plumbing" were to be seen on the Sivers, G. & E. Bradley (U.K.), Sperry and Demornay Bonardi stands. The last-named display was again notable for the high frequencies covered, now up to 140 kMc/s (2.15 mm wavelength)! The section of some of the waveguides was only $1 \times 2\frac{1}{2}$ mm.

The emphasis in valve displays was also largely on microwave types. Huggins continue to specialize in travelling-wave types, of which a considerable variety were shown. Sperry high-power klystrons are now obtainable for frequencies up to 6 kMc/s. The Raytheon range included carcinotrons, and a new type of crossed-field valve called the platinotron, which can be used as a broad-band amplifier or an oscillator.

One thinks nowadays of oscillographs only in terms of the c.r.t. variety, but a reminder that this

XUM

is not the only or original sort appeared in the Brush Type BL-274 Four-Channel Portable Oscillograph, which has four pens for simultaneous recording. Another new data recorder was the Varian Graphic Recorder Model G-10. Although small in size, this instrument records on a large scale, the pen being motor-driven in a servo system.

Although at first glance an orthodox high-performance c.r.t. oscilloscope, the Disa (Denmark) Universal Indicator 51.B00 is unusual in that the deflection is produced by the output of what in effect is an f.m. receiver, driven from an oscillator frequency-modulated by a capacitive or inductive transducer. It is therefore especially suitable for mechanical investigations. The frequency range is 0 to 0.5 Mc/s.

Besides the microwave equipment already mentioned, G. & E. Bradley showed a number of instruments designed for the fighting services, including a crystal-impedance meter (UE.24) for measuring the resistance of overtone quartz crystal units in the frequency range 10 to 140 Mc/s, and an electrolytic capacitor reforming unit (UE.23).

New types of germanium and (especially) silicon diodes and transistors were shown. Sperry miniature (about 2×7 mm) silicon diodes have remarkably high current ratings, for temperatures from $-55°$ to $+200°$C. Two transistor testers were to be seen: one, by Norden-Ketay (BCT-300), is a curve tracer for use with an oscilloscope; the other, by Electronic Research Associates (TT.11A), is for acceptance tests, in which the transistor under test is compared with a standard, the particular test required being put into operation by one of a number of spring-loaded keys.

Some interesting examples of circuit printing were shown by Lares S.R.L. (Italy), notably tuners for multi-channel television and f.m. receivers, which include wafer switches and printed inductors. An entire circuit-etching machine, for rapid automatic production, was exhibited.

Considerable interest, too, was shown in samples of multi-conductor (up to 50) flat cable by the Tape Cable Corporation. The conductors, of rectangular-section copper rated at 1 A, are embedded in transparent polyester tape. In spite of its thinness, the "cable" is rated at 300 V. The capacitance between adjacent conductors is only 5 pF/ft.

BOOKS RECEIVED

Radio Technology, by Ernest J. Vogt. Course of study designed to equip students for the Federal Communication Commission licence examination for radio operators. Treats radio as an extension of electrical engineering principles and covers telegraphy, telephony, television transcription and facsimile. Pp. 556; Figs. 325. Price 45s. Sir Isaac Pitman & Sons, Ltd., 39, Parker Street, London, W.C.2.

High Fidelity Sound Reproduction. Collection of ten essays: "Subjective and Objective Judgment of Performance," by Graham Higgs; "Acoustics of Sound Reproduction," by James Moir; "Multiple Channel Systems," by M. B. Martin; "Amplifiers and Pre-amplifiers," by G. W. Tillett; "Dynamic Loudspeakers," by P. D. Collings-Wells; "Loudspeaker Enclosures," by E. T. Jordan; "Electrostatic Loudspeakers," by R. L. West; "Record Reproduction," by S. Kelly; "Tape Recordings," by M. B. Martin; "Radio Reproduction," by R. S. Roberts. Pp. 200; Figs. 151. Price 20s. George Newnes, Ltd., Southampton Street, London, W.C.2.

High Quality Sound Reproduction, by James Moir, M.I.E.E. Treatise on the characteristics of music and speech and the human hearing mechanism leading to an assessment of the requirements of a sound reproducing system and detailed analysis of microphones, amplifiers, disc and magnetic recording systems, loudspeakers, stereophonic systems and the acoustics of rooms. The book is one of a series of Advanced Engineering Textbooks sponsored by the B.T.H. Company and published by Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Pp. 591; Figs. 343. Price 70s.

Gasentladungsröhren in der Nachrichtentechnik. Supplement No. 9 (1957) to *NTZ*. A collection of twelve papers on the use of gas discharge tubes in telecommunications. Pp. 62; Figs. 95. Price DM. 8.50. Friedrich Vieweg & Sohn, Burgplatz 1, Braunschweig, Germany.

Worked Radio Calculations, by A. T. Witts, A.M.I.E.E. Revised second edition with adaptations where necessary to bring into use the M.K.S. system of units. Pp. 155; Figs. 77. Price 12s 6d. Sir Isaac Pitman & Sons, Ltd., Parker Street, London, W.C.2.

Television Interference, Its causes and Cures, by Phil Rand. Illustrated American treatise giving photographs of typical forms of interference distortion and circuit diagrams indicating possible methods of amelioration. Pp. 56; Figs. 91. Price $2. Nelson Publishing Company, P.O. Box 36, Redding Ridge, Conn., U.S.A.

British Standards Yearbook 1958, gives lists and synopses of British Standards specifications, codes of practice, etc., complete to 31st December, 1957. Pp. 515. Price 15s. British Standards Institution, 2, Park Street, London, W.1.

Telecommunications Principles, by R. N. Renton, C.G.I.A., M.I.E.E. Second edition revised to use rationalized M.K.S. units throughout and designed to cover the syllabuses of the City and Guilds examinations Telecommunications (Principles) Grades I, II and III. Pp. 446; Figs. 641. Price 45s. Sir Isaac Pitman & Sons, Ltd., 39, Parker Street, London, W.C.2.

The Economic Development of Radio, by S. G. Sturmey. One of a series of studies prepared by members of the Department of Political Economy of University College, London, showing the factors which have determined the growth of the industry, with special reference to marine radio, point-to-point communications and broadcasting. Pp. 284. Price 30s. Gerald Duckworth & Co., Ltd., 3, Henrietta Street, London, W.C.2.

International Electronic Tube Handbook. Third edition gives principal data on many European and American receiving valves, thyratrons, transistors and cathode ray tubes in semi-pictorial form. Equivalents and near equivalents (including British and American service types) are also given. Introduction is in nine languages. Pp. 334. Price Fl.7.50 (Dutch). De Muiderkring, Postbox 10, Bussum, Netherlands.

Tabellen und Kurven zur Berechnung von Spulen und Übertragern, by Richard Feldtkeller. Third edition gives magnetic data at various audio frequencies for laminations of typical high-permeability materials; and also the inductance and d.c. resistance of coils wound on cores of various sizes and any permeability. Pp. 69. Price 10DM. S. Hirzel Verlag, Stuttgart N., Birkenwaldstrasse 185.

Radio Navigational Aids

DIGEST OF PAPERS PRESENTED AT THE I.E.E. NAVAID CONVENTION

A SYMPOSIUM of aeronautical and marine radio aids to navigation was held at the Institution of Electrical Engineers in London on March 27th and 28th last when eighteen papers were presented dealing with the many contributions radio and radar are making to speedier and safer travel by air and by sea. The Convention was inaugurated by an address by Marshal of the Royal Air Force Lord Douglas of Kirtleside, whose knowledge of both service and civilian aeronautical requirements is probably unrivalled to-day.

The Convention was divided into five sessions, two on the first day and three on the second, the inauguration address being followed by a general review of aeronautical and marine navaids, while the second session dealt with medium- and long-range systems. The three sessions on the second day dealt with range and bearing systems, generally referred to as rho-theta systems; airfield and harbour approach aids with which was included radio altimeters, marine and ground radars. Thus every aspect of the subject was adequately covered.

In this review of the Convention the established and well-known systems such as Decca, radio beacons, radio direction finding (including radio compasses) and surveillance, ship and airborne radars have been omitted in order that the lesser-known systems can be more fully described.

Three papers were devoted to Doppler navigation and although it is one of the latest systems for use in aircraft it was apparently first suggested as far back as 1930. Owing to the scarcity of suitable radio equipment at that time for the very high radio frequencies involved nothing came of it until about 1952 when a prototype equipment was produced for the Royal Air Force.

The basic principles were explained in *Wireless World* (May, 1957) and a description was given of a civilian version of the military model in the August 1957 issue of this journal. Both equipments are pulse modulated and operate in the 8,500 to 9,800Mc/s, or "X," band. Details were given in one of the papers of a new c.w. Doppler system which has been developed in Australia. It is restricted to low power owing to the unavailability at present of high-power klystrons suitable for airborne use. Two fixed pencil beams are radiated downward and to the rear of the aircraft and the high concentration of the available radiated power, coupled with the use of high-sensitivity receivers, enables satisfactory operation up to 10,000ft altitude, and up to speeds of 250 knots, to be effected over water, for which purpose it was evolved. In the subsequent discussion mention was made of an f.m. Doppler c.w. navigation system being experimented with in Canada. With an effective radiated power of 2 watts operation up to an altitude of 60,000ft is possible and the equipment is said to be smaller, lighter and more economical than current pulsed systems.

One of the papers on Doppler navigation gave a table of the failures of components experienced in this equipment and the opinion was expressed that for civil applications considerable improvement in reliability would be required before the system becomes a serious competitor of the simpler types of radio navaid in current service on the world's airlines.

A new navaid for aircraft is "Inertial Navigation." It employs no external reference apart from a departure "fix" and no radio transmission or reception is involved. Although it is not a radio aid it was included in the Convention because it relies extensively on electronic equipment and in its present form is combined with a radio aid of one kind or another. In operation it relies on the measurement of forces constraining a body of known mass when the speed or direction of the aircraft is changed. By means of integrators and computers this data is converted into velocity and position. The basic instruments employed are gyroscopes and accelerometers. Its principal characteristic is that good short-term accuracy at a high rate of information is supplied, but it needs external references for long-term accuracy and for this reliance is generally placed on one of the existing forms of radio navaid, but an alternative independent reference could be used.

A new system of long-range navigation based on the Decca Navigator is under evaluation over the North Atlantic between Newfoundland and the British Isles. Known as Dectra it employs two stations at each end of the 2,000 or so miles of sea route and these lay down a hyperbolic pattern of radiation. Each pair of stations operates alternatively on a single frequency in the 70-kc/s band, the signals being switched from master to slave stations of each pair in time sequence. A local oscillator in the aircraft receiver is held in phase with the master station's signal and acts as a phase reference when the slave station is transmitting. The nearest pair of stations to the aircraft provides the hyperbolic pattern for navigating to the mid-point of the route whence the receiver is retuned to the stations at the opposite end of the route.

Time sharing a frequency between master and slave stations is adopted in preference to frequency diversity as it ensures better correlation in the propagation where ionospheric reflections have to be relied on, as is necessary in the case of Dectra. The two radio frequencies at each end of the route are interrelated so as to provide a further hyperbolic pattern for determination of distance. As signals propagated via the ionosphere are always liable to interruptions the local oscillator in the aircraft receiver must have exceedingly high stability, long-term accuracy and memory and can replace when necessary signals which may fade out for an hour or more. It was said that this is believed to be the first example of a high-stability frequency reference employed in airborne equipment for distance measurements. Mention was also made of a related long-range c.w. system known as Delrac using radio frequencies of the order of

12kc/s and master and slave stations operating in pairs with very long base lines up to 1,000 miles.

Of the various new medium-range navigational systems Tacan seems to be the most advanced in development. It operates from a single site and is a beacon of the interrogator-responder type giving range and bearing to an aircraft provided the site of the beacon is known. It operates in the 962 to 1,213-Mc/s band and allows for 126 clear radio channels to be employed and immediately selected on the aircraft receiver. Up to 100 interrogating aircraft signals can be handled simultaneously by a single Tacan beacon and coded interrogation pulses are employed for identification purposes.

For bearing information a Tacan beacon radiates two signals, one for coarse bearings taking the form of a cardioid pattern of radiation produced by using a vertical stack of dipoles with a cylinder revolving around it carrying a parasitic element in the form of a vertical metal strip. The cylinder, and hence the cardioid, revolves at 900 r.p.m. and in the aircraft receiver this is resolved into a sinusoidal amplitude of modulation at 15c/s. As the rotating cylinder passes through a fixed point, generally true north, a pulse of modulation is superimposed on the cardioid and in the aircraft receiver this is used for comparing the phase of the modulated signal at maximum amplitude with that of the true north marker pulse. From this the bearing is approximately fixed.

Also superimposed on the rotating cardioid pattern is a 135-c/s modulation produced by an outer glass-fibre cylinder rotating about the aerial and having nine vertical parasitic elements. Further marker pulses are radiated every 40° of this cylinder's rotation. The rotating cardioid pattern locates the bearing in one of nine 40° sectors and phase comparison between the peaks of the subsidiary 135-c/s modulation and the second set of marker pulses accurately fixes the bearing within the appropriate 40° sector. Bearings are displayed on an instrument dial.

Distance from the beacon is determined by the well-known interrogator-transponder (D.M.E.) principle by measuring the time interval of a round-trip pulse, allowing for the delay in the beacon's response. In the U.S.A. a compromise version of Tacan is being adopted. This is to enable the existing chain of v.h.f. omni-range beacons (V.O.R.) to be utilized and the common military-civil system is known as V.O.R.T.A.C. This consists of ground installations comprising co-sited or correlated Tacan and V.O.R. beacons. Civil aircraft use V.O.R. for bearings and determine distance by additional equipment compatible with Tacan and known as D.M.E.T. Military aircraft use Tacan for both distance and bearing.

The integration of military and civil requirements has brought in its train a further facility described as "data links." It is a method of passing information from air to ground and ground to air and requires only limited additional equipment in the aircraft and some additions on the ground to transmit and receive a certain number of pre-selected types of message and send quantitative data in both directions. For ground-to-air service additional groups of code pulses are inserted in the normal signal and these carry information in binary group form and by pulse-time modulation. For air-to-ground messages a number of pulse-time modulated groups convey such information as aircraft identity, bearing, distance and speed.

The attempt to reach some sort of compatibility between closely related systems is sound common sense and should in the long run lead to a reduction in the number of radio aids to navigation which differ only just sufficiently to render them non-compatible.

An example of this might be said to be a British system very similar to Tacan and which is known as V.O.R.A.C. being based on the V.O.R. type of beacon and which operates in conjunction with the existing v.h.f. radio telephone equipment in aircraft. Like Tacan bearings are obtained by the rotating cardioid principle with a superimposed star-shaped sinusoidal modulation, but in V.O.R.A.C. the star or "daisy" pattern is supplied by a sub-carrier offset about 50kc/s from the main carrier. Limited distance measuring facilities (D.M.E.) are incorporated by using a two-tone modulation on the cardioid pattern and these are superimposed on the aircraft R/T transmission and returned to the ground beacon where the tones are separated out and used for measuring distance by comparing the phases of the transmitted and received tones. The fundamental difference between V.O.R.A.C. and Tacan is that in the former system distance is measured on the ground and in the latter in the aircraft.

The only significant development in the orthodox form of radio direction finding in recent years would appear to be the commutated aerial system (C.A.D.F.) in which a ring of vertical aerials is used and sequentially connected to the receiver. It is a ground system, of course, and exploratory investigation has been made on the h.f., v.h.f. and u.h.f. bands. One system for use on the 100- to 156-Mc/s band employs 18 unipole aerials spaced round the circumference of a circle 4 metres in diameter and mounted on a wire-mesh "earth" some 14 metres in diameter. Electronic switching incorporating germanium diodes is used to commutate the aerial system. Switching is effected at 50c/s which in effect phase-modulates the received signal at this frequency. The diameter of the ring of aerials, also the signal frequency, plays a part. In effect the commutated aerial system can be likened to a pair of vertical dipoles mounted on a rotating horizontal arm about a half-wavelength long. The phase difference of the signals in the aerials is extracted by splitting the i.f. output in the receiver into two channels, one passing through a delay network with a delay equal to the commutation time between adjacent aerials. By demodulating the two signals in a single stage a sinusoidal output voltage is obtained having a phase dependent on the direction of arrival of the signal. Comparing this with a reference voltage derived from the commutating oscillator provides bearing information.

A commutated aerial u.h.f. direction finder has been developed, similar in basic principles to the v.h.f. one, for use on the 225 to 400-Mc/s band. In this installation the aerial consists of a fixed vertical dipole surrounded by a fibre-glass cylinder carrying several vertical metal strips, the cylinder revolving at 2,400 r.p.m. and thus imparting a 40-c/s sinusoidal modulation to the received signal. Comparing the phase of the demodulated signal with that of a 40-c/s reference voltage derived from an alternator coupled to the revolving cylinder gives bearing information. This is displayed as a radial line on a c.r. tube. Provision is made for receiving R/T simultaneously on the same equipment.

Flip-Flop Stability

EFFECT OF CHANGING VALVES

By T. G. CLARK,* A.M.Brit.I.R.E.

THE article, "Cathode-Coupled Flip-Flop," published in *Wireless World* for January 1958 averred that this circuit, frequently considered to be unpredictable, was in fact predictable. It is the object of this note to offer further experimental justification in support of this statement.

For the purposes of the experiment the circuit of Fig. 1 was used, and the design was based upon the published characteristics of the E88CC. A number of E88CC's were tried in the circuit, both pulse duration and amplitude being observed. Without changing any circuit constants, a number of ECC81/12AT7's were similarly tried. These two valves are quite dissimilar as is indicated by the published parameters shown in Table 1.

Table 1

	E88CC	ECC81
V_a (V)	90	100
I_a (mA)	15	3
V_g (V)	−1.2	−1
μ	33	62
g_m (mA/V)	12.5	3.75
r_a (kΩ)	2.65	16.5

From equation (6) of the original article, reproduced here as equation (1), it may be argued that for stability of pulse duration the logarithmic term should be dominated by stable quantities.

$$t_o = K C R$$

$$\text{where } K = \log_e \left\{ \frac{i_3 + i_1 R_3/R_5 - i_2}{i_3 - i_1} \right\} \qquad (1)$$

$$\text{and } i_3 = E_g/R_5$$

Considering the terms contained in the numerator of equation (1): i_3 is not dependent upon the valve, i_1 is dependent upon the valve but is subjected to control by negative feedback, and i_2 is wholly dependent upon the valve although, by using a diode clamp, this term may also be stabilized. Design considerations require that i_2 should be greater than i_1 and therefore the ratio R_3/R_5 should be made large in order that i_2 should not unduly influence equation (1). In the denominator, there is a stable term, i_3, that can be large with respect to i_1, a feedback controlled term.

As discussed in the original article, i_3 should not be made large by excessive reduction of R_5. Moreover, R_5 has a minimum value dictated by the maximum anode dissipation of the normally-on stage. It was therefore decided to accept a minimum cathode load of 2.7 kΩ and to reduce the anode voltage of V_2 to a suitable value for the E88CC. Keeping E_g at +250V produces a value $i_3 = 92.5$mA. Considering now the ratio R_3/R_5, it was decided initially to try $R_3 = 82$kΩ, thus giving a ratio of 30.4. The value of i_2 was not stabilized for this investigation since the object was to swamp this term if possible.

The following circuit parameters now exist:—

$V_{a1} = +250$V, $V_{a2} = +100$V, $E_g = +250$V,
$R_5 = 2.7$KΩ, $R_3 = 82$ kΩ, $R_3/R_5 = 30.4$
and $i_3 = 92.5$mA

From the published characteristics of the E88CC the following data were obtained:—

$i_1 = 2.6$mA at −1V bias
$i_2 = 16.6$mA at zero bias

$$\text{hence, } K = \log_e \left\{ \frac{92.5 + 2.6 \times 30.4 - 16.6}{92.5 - 2.6} \right\}$$

$$= \log_e (1.72)$$

$$= 0.542$$

Let $t_o = 100$ μs, and C = 180 pF
Then R = 1 MΩ

Since $i_1 = 2.6$mA, this will produce +7V across R_5. Thus the potentiometer formed by R_1 and R_2 must be such as to produce +6V at V_1's grid. Actually the preferred values selected gave a value of +5.7V. A slightly narrow pulse was thus anticipated but this was not of consequence since it was pulse stability that was being investigated.

The results for nine E88CC's, taken at random, are shown in Table 2.

Table 2

Valve No.	Pulse Amplitude (V)	Pulse Duration (μs)
1	50	80
2	50	80
3	50	82
4	50	82
5	50	83
6	52	82
7	51	81
8	52	80
9	50	81

*Decca Radar Ltd.

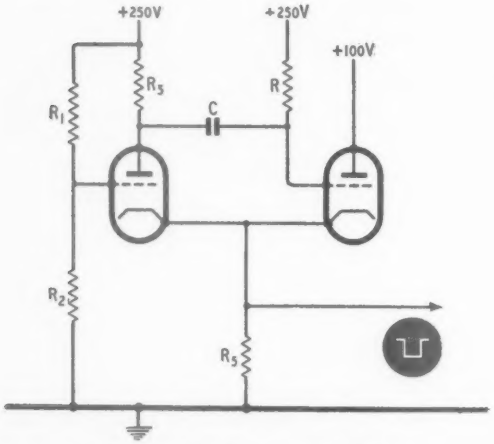


Fig. 1. Basic flip-flop circuit used.

A number of ECC81/12AT7's were then put into the circuit. The results are shown in Table 3.

Table 3

Valve No.	Pulse Amplitude (V)	Pulse Duration (μs)
1	15	95
2	19	95
3	25	90
4	18	91
5	16	95
6	13	95
7	18	91
8	14	95
9	14	90
10	15	91

It is seen that a substantial change of valve parameters caused a change in the mean pulse duration of only 11 μs.

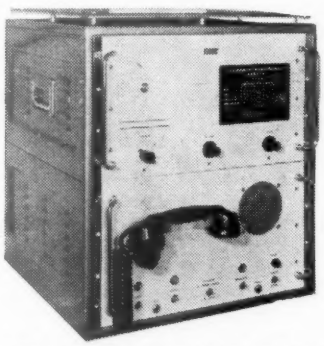
A further test was completed in which the circuit was modified by increasing R_3 to 470 kΩ and modifying R_2 appropriately, other circuit components being left unchanged. Thus R_3/R_5 became 174. It may be noted that for such a value of R_3 the valve V_1 becomes virtually a constant current device for small changes of grid potential.

As before, nine E88CC's and ten 12AT7's were tried. The mean duration for both cases was 125 μs compared with the calculated value of 124 μs; and the maximum spread was ± 5 μs except for two "rogues" giving 112 μs pulses.

The foregoing results adequately demonstrate the original contention. However, it should be appreciated that for the purposes of this exercise the stability of the pulse duration only was the consideration. It may be that other requirements, for example, a high duty ratio, would preclude the use of these methods.

Single-Sideband Radiotelephone

IT is most unusual to find the single-sideband (s.s.b.) system of radiotelephony employed in the smaller kind of commercial transportable communications equipment, but this system is used, with fully suppressed carrier, in the Racal Type TRA55 radiotelephone set. The principal advantages of s.s.b. are that a narrower channel than normally required for double-sideband systems can be used and interference is considerably reduced; but perhaps the most important of them all is that considerably more r.f. power is radiated for a given input power than with orthodox systems. Alternatively the set is smaller for a given power output.



Racal Type TRA55, single-sideband radiotelephone.

The TRA55 is rated at 60 watts output and operates on four crystal-controlled channels, two in the 3 to 6-Mc/s band and two in the 6 to 12-Mc/s band. It is simple to operate, having been designed for use by unskilled personnel, and a single switch simultaneously adjusts both transmitter and receiver to the required channel and leaves the set ready for reception. For transmission a switch in the handle of the telephone-microphone handset has to be depressed. A built-in loudspeaker can be used, if required, in place of the telephone earpiece.

A metal cabinet measuring 20½in × 20½in × 24½in high houses the equipment, which complete weighs 160lb. It is designed for operation on a.c. supplies of 100 to 125V or 200 to 250V, 40 to 60 c/s and the power consumption is 95W on reception and 300W on transmission. It is fully tropicalized and costs £495, less crystals, in the U.K.

The makers are, Racal Engineering Ltd., Western Road, Bracknell, Berkshire.

NEW LINK FOR I.T.A.

Intermediate and output stage travelling-wave tubes in the Marconi Type HM 200 u.h.f. terminal transmitter.

WHEN the I.T.A. East Anglian television service begins in the summer of 1959 it will be connected to London by a u.h.f. link operated by the G.P.O. in the range 1.75-2.3 kMc/s. The terminal equipment chosen is the Marconi Type HM 200, which uses travelling-wave tubes throughout and has a power output of 10 to 15 watts. Intermediate repeaters (Type HM 250) will be used at Ongar Sibleys and Ousden, and the terminals will be at the Museum Exchange in London and at a station between Norwich and Ipswich. The link is designed to carry one television signal of 405, 525, or 625 lines (black and white or N.T.S.C. colour); alternatively it can be used for 600 telephone channels.

WORLD OF WIRELESS

B.B.C. 625-line Tests

EXPERIMENTAL transmissions in Band V, using the 625-line standard with f.m. sound are to begin from the Crystal Palace station on May 5th. It will be recalled that last November the B.B.C. started a series of u.h.f. tests initially using the 405-line standard with a.m. sound. The E.M.I. transmitters installed for this series of tests have now been modified for 625 lines with negative modulation and f.m. sound (±50 kc/s), using a bandwidth of 7 Mc/s. Vision signals will continue on 654.25 Mc/s, but the sound carrier will be changed to 659.75 Mc/s.

The material transmitted during the 405-line tests has been the same as that radiated by the London Band I transmitter, but for the 625-line tests pictures will be produced at the Lime Grove studios by Cintel flying-spot film-scanning equipment and sent by coaxial cable to the Crystal Palace.

The date on which the tests begin was announced by Sir Harold Bishop during an I.E.E. discussion on u.h.f. test transmissions on April 9th. During the discussion several speakers expressed the view that u.h.f. transmitters will need an e.r.p. of 1 or 2 MW in order to provide an adequate signal/noise ratio. One speaker said that it would be possible to cover about 50% of the population with five stations, each of one megawatt e.r.p. Reports from various speakers indicated that low signal/noise ratio and pronounced local variations in signal strength were the main problems in reception.

7,000,000 Components a Day

COMPONENT production in the U.K. is increasing at a rate in excess of 20% per annum, and it is estimated that current production is approximately 7M components every working day.

It is not possible to give an accurate statistical breakdown of component distribution throughout the radio and electronics industry, but the table, compiled from the annual report of the Radio and Electronic Component Manufacturers' Federation, gives a rough guide to the number and value of the components supplied to the major sections.

Industrial Group	Components (M)		Value (£M)	
	1956	1957	1956	1957
Domestic equipment	600	725	21.5	25.5
Professional equipment ...	450	525	25.0	28.5
Direct export	275	300	16.0	19.0
Sound reproducing equipment	100	125	6.0	7.0
Other*	75	75	12.5	13.0
	1500	1750	81.0	93.0

* Defence, Replacements and Retail Sales.

The principal overseas market for components is still Australia, but the United States is by far the biggest market for sound reproducing equipment—over £3M worth last year. The second largest purchaser of S.R.E. was Canada (£875,000).

The presentation of the 1957/58 report of the R.E.C.M.F. marks the 25th anniversary of the founding of the Federation with 38 member firms. Output was then approximately 100M components a year, valued at £5M. The output of the present 201 member firms is some 1,750M components a year, valued at over £90M.

S.E. Coast TV

THE difficulty of providing a television service in the south-east corner of England is being overcome by the B.B.C. by installing two transmitters—one to serve the Dover area and the other Folkestone.

In order to provide a service in the Dover area without delay a temporary station has been installed at Swingate, where the permanent station will be built. Test transmissions in Channel 2 began on April 8th and the station came into service on April 21st. The permanent transmitter will use a vertically-polarized directional aerial, giving an e.r.p. of between 0.25 and 1 kW.

Folkestone will be served by a satellite transmitter, which will re-broadcast signals picked up from another station. It will operate in Channel 4 with horizontal polarization and will have an e.r.p. of 10 watts.

Exhibitions and Conferences.—Since preparing the list of exhibitions and conferences, which will be found on page 249, we have received details of the following: International Swedish Industries Fair, Gothenburg, May 10th-18th, at which emphasis is being placed on sound radio and television (U.K. representatives John E. Buck & Co., 47, Brewer Street, London, W.1); Radio Hobbies Exhibition, Royal Horticultural Society's Old Hall, London, S.W.1, November 26th-29th, organized by P. A. Thorogood, 35, Gibbs Green, Edgware, Middlesex; Industrial Electronics Exhibition, Rutherford College of Technology, Newcastle-upon-Tyne, May 20th-23rd, organized by Farnell Instruments, Ltd., York Road, Wetherby, Yorks.

WRITING PRIZE—E. J. Gargini, A.M.Brit. I.R.E., (right) being congratulated by F. W. Perks (chairman of B.R.E.M.A.) on winning one of the 25-guinea premiums presented annually by the Radio Industry Council. Full details of the awards were given in the preceding issue. Mr. Gargini, who is in the research division of E.M.I. Electronics, Ltd., contributed the article on "An Alternative Colour TV System" which appeared in Wireless World *for August 1957.*

V.H.F./U.H.F. Convention.—The 4th International V.H.F./U.H.F. Convention organized by the R.S.G.B. and the London U.H.F. Group will be held on May 17th at the Prince of Wales Hotel, Kensington, London. The convention and exhibition opens at 10.0. During the afternoon session (from 2.0) three papers will be delivered: "Auroral propagation at v.h.f." by T. R. Kaiser (Sheffield University), "Some problems in u.h.f. broadcasting" by Dr. A. J. Saxton (D.S.I.R.), and "V.H.F./U.H.F. radio-frequency amplifiers and aerials" by C. de Leeuw (Netherlands Govt. station PE1PL). The convention dinner is at 7.0. Tickets, price 3s 6d for the exhibition and convention or 22s 6d including the dinner, are obtainable from F. Lambeth, 21, Bridge Way, Whitton, Twickenham, Middlesex.

Test transmissions, with an e.r.p. of 1 kW, from the site of the I.T.A.'s Chillerton Down, Isle of Wight, transmitter begin on April 28th. They will be radiated in Channel 11 (vision 204.75 Mc/s, sound 201.25 Mc/s) from 10.0 to 12.30 (Mon. to Sat.) and from 2.0 to 5.30 (Mon. to Fri.). These vertically polarized pilot transmissions will continue until early in August when it is expected full-power tests (100 kW e.r.p.) will begin.

I.T.A. In East Anglia.—A site at Mendlesham, near Stowmarket, East Suffolk, has been approved for the I.T.A. East Anglian station. It will serve practically the whole of Norfolk and Suffolk, and by using a directional aerial with maximum radiation (about 200 kW) to the N.W., will have Peterborough on its western boundary. The station is planned to be brought into service in the autumn of 1959.

I.T.A.'s North-Eastern transmitter being built at Burnhope, about five miles south-east of Consett, Durham, is to operate in Channel 8. Its carriers are slightly off-set, the actual frequencies being 189.75675 Mc/s vision and 186.270 Mc/s sound. It will use a directional aerial giving a vision e.r.p. of from 7.5 to 100 kW.

R.E.C.M.F. Council.—The following representatives of member firms of the Radio and Electronic Component Manufacturers' Federation have been elected to the council of the Federation for 1958/59: K. G. Smith (N.S.F.), chairman; Hector V. Slade (Garrard), vice-chairman; C. M. Benham (Painton), E. E. Bivand (S.T.C.), S. H. Brewell (Hunt), P. D. Canning (Plessey), E. M. Lee (Belling & Lee), H. J. Mildren (Colvern), Dr. G. A. V. Sowter (Telcon), G. J. Taylor (Bakelite), W. F. Taylor (T.C.C.) and J. Thomson (Morganite Resistors).

Television-sound licences in the U.K. increased during February by 96,476 bringing the total to 7,994,723, and sound-only licences decreased by 80,714 to 6,662,313 (including 330,238 for car radio). The overall February increase in broadcast receiving licences was, therefore, 15,762, making 14,657,036 at the end of the month.

Presentation of Technical Information.—To encourage the clear presentation of scientific material in a form readily understandable by scientists working in other fields and by laymen, *Research*, the journal of science and its application to industry, is again sponsoring an essay competition. Particulars of the Waverley Gold Medal Essay Competition, as it is called, which offers three prizes (£100 and two of £50) are obtainable from the Editor, *Research*, 4 and 5, Bell Yard, London, W.C.2.

B.R.E.M.A.—The British Radio Equipment Manufacturers' Association, the domestic receiving equipment makers' organization, has moved from 59 to 49, Russell Square, London, W.C.1. The new telephone number is Langham 3586.

British Radio Cabinet Manufacturers' Association recently moved to Audrey House, 5-7, Houndsditch, London, E.C.3. The telephone number is unchanged (Avenue 2707).

Computer Programming.—A summer school in programme design for automatic digital computers will be held in the University Mathematical Laboratory at Cambridge, September 15th-26th. The course will give a basic training in the mathematical use of digital computers, dealing with the processes involved and their embodiment in programmes which specify the operation in detail. Lectures and practical classes will be held in the design of programmes for EDSAC 2. A detailed syllabus and form of application for admission may be obtained from the Board of Extra-Mural Studies, Stuart House, Cambridge. Completed application forms must be returned by June 16th.

Summer schools in instrumentation and automatic control are again being organized by the department of science of the City of Gloucester Technical College. There will be a five-day course on process control (June 30th-July 4th) followed by a five-day course on servo-mechanisms (July 7th-11th). The fee for each course is 9gns.

The first recipient of the Baird Memorial Prize introduced by the Royal College of Science and Technology, Glasgow, in 1955, is D. T. A. Blair, who, having gained a first-class honours degree, is now undertaking a three-year research course at the College. It is announced that the first biennial lecture introduced under the Baird memorial scheme will be given in 1959 by T. H. Bridgewater, superintendent engineer, Television Outside Broadcasts, B.B.C.

Two Fellowships, each worth £1,000 p.a., one at the University of Birmingham and the other at the College of Technology, Birmingham, are being sponsored by the Wilmot Breeden group of companies whose manufacturing interests include electronics as well as motor vehicle and gas turbine components and hydraulics. Particulars are obtainable from the secretary, Wilmot Breeden (Holdings), Ltd., Amington Road, Birmingham, 25.

Patents Information Service.—Instead of the annual publication of the "List of Patents in Force" the Patent Office has introduced a service whereby information will be supplied as to whether any particular patent is in force on payment of 1s for the first patent and 6d for each succeeding one. This is one of the changes introduced under the Patents Rules, 1958 (S.I. 1958 No. 73).

Symposium on R.F. Transistors.—Some 80 engineers and physicists from about 30 firms and other organizations attended the third annual symposium on transistors held at the Borough Polytechnic, South East London, from March 31st to April 2nd. The theme of this year's symposium was the manufacture, design, performance and application of transistors in r.f. and v.h.f. circuits.

More Forward Scatter.—Supreme Headquarters Allied Powers Europe (SHAPE), has called for tenders for the supply and installation of 168 aerials for tropospheric scatter transmission. The approximate value of the contracts will be £3.4M. The installations are to be completed by mid-1960.

Hungary's new 30-kW television station built on a hill overlooking Budapest, is now transmitting daily. Hungarians now have to pay for a television receiving licence costing about 30s a month (about 3 per cent of a factory worker's monthly earnings). A combined television-sound licence costs about 37s.

I.R.E. (Aust.).—Last year the Institution of Radio Engineers, Australia, celebrated the 25th anniversary of its foundation and the December issue of its *Proceedings* is a silver jubilee number. At the end of its first year of operation the Institution's membership was 108, today it is nearly 1,900.

V.H.F. broadcasting is to begin in Hungary this year. Test transmissions have been radiated by a 1-kW transmitter for some time and a new 3-kW station is to be built this year.

Personalities

Sir George Barnes, M.A., D.C.L., has become president of the Television Society in succession to **Sir Vincent de Ferranti,** who retired at his own request in December. Sir George, who was from 1950-1957 B.B.C. director of television, is now principal of the University College of North Staffordshire. He joined the B.B.C. in 1935 and was for two years in charge of the Third Programme.

Hugh Townsend, C.B., B.A., has retired from the International Telecommunication Union which he joined in 1950 as assistant secretary-general. He is 67. For six years prior to going to Geneva he was director of telecommunications in the Post Office, which he joined in 1914, and was for some years a member of the Government's Television Advisory Committee.

K. G. Smith, technical and sales director of N.S.F., Ltd., is the new chairman of the Radio and Electronic Component Manufacturers' Federation in succession to **Richard Arbib.** Mr. Smith, who is also a director of British Centralab, Ltd., and the Motor and Electronics Corp., Ltd., is a native of South Africa but came to this country over 30 years ago. **Hector V. Slade,** M.B.E., managing director of Garrard Engineering, is this year's vice-chairman.

H. F. Wilson, B.Sc., Comp.I.E.E., and **C. L. G. Fairfield,** M.A., M.I.E.E., have been appointed to the board of the Telegraph Construction and Maintenance Co. Mr. Wilson, who will be managing director of the Telcon cables group, joined the company in 1919 and has successively held the positions of chief chemist, technical manager, and works manager of the Greenwich cable factory. Mr. Fairfield, who has been appointed commercial director of T.C.M.C., joined the company in 1953, prior to which he was for six years with Mullard, latterly as manager of the valve division.

Eric Goodhew, M.I.E.E., chief electrical engineer in charge of laboratories at Philips Croydon Works, Ltd., recently completed 25 years' service with the Philips organization. Mr. Goodhew, who joined the service department of Philips at the age of 24, is chairman of the B.R.E.M.A. committee and the B.S.I. sub-committee on safety of sound and television receivers.

C. P. Ginsburg, manager of advanced video-tape development with Ampex Corp., of California, has received the I.R.E. Vladimir Zworykin Television Prize "for pioneering contributions to the development of video magnetic recording." As announced last December, he is also the recipient of the David Sarnoff Gold Medal of the American Society of Motion Picture and Television Engineers.

E. R. Friedlaender, M.Brit.I.R.E., who has been in the radio and electrical industry for the past 20 years, is now in practice as an industrial consultant. For ten years prior to 1955 he was general manager of Trust Accessories, Ltd. (Manchester). Originally the firm produced only h.f. powder cores, on which subject Mr. Friedlaender wrote several papers, but since becoming part of the Hartley-Baird group in 1949 it has made equipment and sub-assemblies for the parent company. Mr. Friedlaender's address is 102, Ealing Road, Wembley, Middlesex.

Dennis G. Packham.—We regret that in the announcement in our last issue of the appointment of the chief engineer of the I.T.A. North East England television station Mr. Packham's name was mis-spelt.

Dr. S. K. Mitra, professor of physics at the University of Calcutta, has been elected a Fellow of the Royal Society. "Distinguished for his researches in many branches of upper atmosphere physics," Professor Mitra, who graduated from the University of Calcutta in 1912 and received his D.Sc. in 1919, has been head of the University's Institute of Radio-physics and Electronics since its formation in 1949. He was for some time (1942-48) chairman of the Government of India's Radio Research Committee and has been chairman of the Calcutta section of the Brit.I.R.E. since its formation in 1952.

Dr. Robert M. Page, the recently appointed director of research at the U.S. Naval Research Laboratory, "carried the bulk of the design work for the first successful [pulse] radar"—a quotation from Guerlac's "Radar in World War II" included in Sir Robert Watson-Watt's "Three Steps to Victory." Dr. Page was formerly director of research for electronics at the Laboratory, which he joined in 1927.

Aubrey Harris, A.M.Brit.I.R.E., recently appointed chief engineer of the Bermuda Radio and Television Company's television station ZBM-TV, was previously for five years with Marconi's, Chelmsford. Whilst at Marconi's he worked on the development of colour television cameras and associated equipment and was in charge of the installation of colour equipment for the B.B.C. at Alexandra Palace. Before joining Marconi's he was for some time at the G.P.O. Research Station, Dollis Hill.

Graham Phillips, Assoc.I.E.E., A.M.Brit.I.R.E., has been seconded by the B.B.C. to the Kenya Government Broadcasting Service as chief broadcasting engineer. He joined the Corporation as a maintenance engineer in 1940 and in 1946 transferred to the overseas section of the Engineering Information Department. In 1952 Mr. Phillips was seconded as chief broadcasting engineer, Uganda, in which capacity he planned and supervised the installation of equipment for the new Uganda Broadcasting Service. Since returning to this country in 1956 he has been attached to the B.B.C.'s Engineering Information Department.

Maurice H. Easy, head of the development laboratories of Decca Radar, Ltd., has been appointed to the company's board of directors. Like many of the original members of the Decca Radar and Navigator companies, he served in No. 60 Group in the R.A.F. during the war, initially in charge of coastal radar stations and later as a specialist radar officer on the headquarters staff. He joined the Decca organization in 1946. **Charles L. Tayler,** marine manager of Decca Radar, is also elected to the board. He has been with the company since its formation in 1950. He was the first post-war Adjutant of the R.A.F. College, Cranwell.

M. H. EASY

C. L. TAYLER

W. H. Grinsted, O.B.E., F.C.G.I., M.I.E.E., director of engineering of Siemens Edison Swan, has retired. After some years with the National Telephone Co. he joined Siemens in 1911 and in 1945 became chief engineer of the telecommunications department. He served on the Telecommunications Advisory Committee of the City and Guilds of London Institute for many years and in 1950 was elected a Fellow.

G. G. ROBERTS

G. G. Roberts, technical director of Smiths Aircraft Instruments, Ltd., and **J. E. N. Hooper,** of the Ministry of Supply, were presented with the Musick Memorial Trophy by the New Zealand Acting High Commissioner on March 27th. The trophy, which commemorates Capt. Edwin Musick and his companions who were lost in 1938 on the first commercial flight between New Zealand and America, is awarded annually to the person or group making the most practical contribution to the safety of aircraft, especially in trans-oceanic flights. Mr. Roberts and Mr. Hooper share the award for the work they did on cloud and collision warning radar at the Royal Radar Establishment, Malvern. Mr. Roberts left R.R.E. in 1947 and joined the newly formed guided weapons department of the Royal Aircraft Establishment, Farnborough. He joined Smiths in 1954.

J. H. Mitchell, B.Sc., Ph.D., M.I.E.E., head of research at Ericsson Telephones, Ltd., since 1947, and **F. Limb,** factory manager, have been appointed to the board of the company. Dr. Mitchell was a member of the Bawdsey radar research team in 1936, later transferring to the R.A.E., Farnborough, where he took charge of research on radio aids to navigation. For his contribution to the development of radar installations—particularly beam techniques and Yagi aerials—he received an award from the Royal Commission on Awards to Inventors. Mr. Limb has been with Ericsson since 1925. **Col. J. Reading,** who joined the company as export director on leaving the Post Office (where he was assistant engineer-in-chief) in 1955, has been appointed sales director.

C. L. McAllister, Assoc.I.E.E., newly appointed head of Airmec's sales promotion department, was for 16 years in the Air Ministry where he was concerned with the development of air traffic control systems and navigational aids. During the war he was in the R.A.F. and was for some time on Combined Staffs planning navaid systems in Africa and the Near East. In 1955 he went to English Electric's guided weapons division.

A. D. Zemenides, B.Sc.(Eng.), has been appointed technical manager of G. A. Stanley Palmer, Ltd., agents for the German Resista high-stability carbon and wirewound resistors and Deac hermetically sealed nickel-cadmium accumulators. Since obtaining his degree at Northampton Engineering College, London, in 1955, he has been a computer programmer at the G.E.C. Coventry Works.

E. W. Durant, technical director of Telerection, Ltd., is on an eight-weeks tour of the United States and Canada. He is making a survey of the North American markets.

H. Fuller, appointed assistant service manager of E. K. Cole, Ltd., has been in the company's service department for 20 years. His industrial career began in 1926 when he joined the Sterling Telephone Co.

T. W. Chalmers has resigned from the B.B.C., which he joined in 1936, to become director of the Tanganyika Broadcasting Corporation. He is 44. From 1950-56 he was seconded from the B.B.C. to the Nigerian Broadcasting Service, of which he was director. Since returning to this country he has been controller, North Region, where he is succeeded by **Robert Stead.**

D. Lindley-Philip, who for the past nine years has been in Ferranti's Edinburgh laboratories, has joined the recently formed Mann Egerton Electronics, Ltd., as manager. The new company is a subsidiary of Mann Egerton & Co., Ltd., of Norwich and London. Whilst at Ferranti's, Mr. Lindley-Philip was responsible for experimental project co-ordination in the radar navigational aid division.

OUR AUTHORS

A. M. Humby, M.I.E.E., who is well known in the field of radio propagation, writes on asymmetry in long-distance W/T circuits in this issue. Since January, 1951, he has been a member of the British Joint Communications Electronics Board (successor to the original Wireless Telegraphy Board). He entered Marconi's in 1920 after war service during which he was appointed battalion signals officer. In 1929 he joined Cable & Wireless as manager and engineer-in-charge of the Bridgwater W/T station and was subsequently for four years on research and development work. Mr. Humby, who is 62, was seconded to the Admiralty in 1941—subsequently joining the Royal Naval Scientific Service—and was for some time officer in charge of the Inter-Services Ionosphere Bureau.

H. N. Gant, A.M.Brit.I.R.E., who describes a Band V receiver on page 244, is engaged on problems of v.h.f. and u.h.f. communication and on the development of equipment for mobile communications and telemetry with E.M.I. which he joined in 1947. He received his technical education in the Royal Navy and at Manchester Technical College and passed the Brit.I.R.E. graduate exam.—gaining the Institute's S. R. Walker prize—in 1943. He is 47.

David A. G. Tait, author of "Direct-coupled Transistor Amplifier," joined the R.A.F. as an apprentice at Cranwell in 1940. He served in various signal establishments until his release in 1953, when he joined the weapons division of Fairey Aviation Co. He is now senior development engineer in the electronic development division of R. B. Pullin & Co.

L. F. Shaw, at present training as an air radar fitter at the R.A.F. establishment at Yatesbury, contributes an article in this issue on a transistorized transmitter. Born in Australia, he travelled extensively before entering on a four-year engagement in the R.A.F. He has been employed by R.C.A. and English Electric in America, A.W.A. and Philips in Australia and Decca and Tannoy in this country.

OBITUARY

Sir James Swinburne, F.R.S., who celebrated his 100th birthday on February 28th, died on March 30th. As mentioned in our centenary notice last month, Sir James was an electrical engineer by profession, but about 50 years ago entered the chemical field, becoming a pioneer in plastics.

William Davies, M.B.E., the first official radio officer appointed by the Marconi Marine Co., has died at the age of 79. A native of Holyhead, he began his career as a G.P.O. telegraphist and joined Marconi's in 1902. He went to sea in the Allan liner *Parisian* in 1903 and can be said to have inaugurated the regular marine radio service. "Billy" Davies served through both world wars and was off Arromanches on D-Day.

News from the Industry

Decca.—In his report on the financial year ended March, 1957, E. R. Lewis, chairman of the Decca group, announced a profit of £1,402,514; an increase of £370,321 on the previous year. After allowing for taxation the net profit was £581,206. The turnover was over £17M, some £4M more than in the previous year. Reviewing the current year he stated that the cumulative total of hire and sale contracts for the Navigator at January 31st was 4,500 units, of which some 1,600 are in fishing trawlers.

Marconi.—The annual reports of both Marconi's W/T Co. and the Marconi Marine Co. show increased profits on the previous year. After deducting all charges, but before allowing for taxation, the group profit was £1,075,938, an increase of £130,020 on the previous year. The turnover of the Marine Co. was a record resulting in a profit of £622,892—before allowing for taxation.

Amphenol (Great Britain) Ltd., formed jointly a few months ago by Gas Purification & Chemical Co. and Amphenol Electronics Corp., of Chicago, has become a wholly owned subsidiary of the American company. On May 1st the company will be moving to a new factory and office premises at Burgess Hill Industrial Estate, Victoria Road, Burgess Hill, Sussex.

British Communications Corp.—"With a view to effecting changes in the organization as a preliminary to the expansion of the company's activities" D. D. Prenn, the chairman, has assumed executive control. He is also chairman of Rola-Celestion and Truvox. J. A. D. Timms and F. P. Nurdin have been appointed to the board of directors. K. Jones, formerly general manager, has left the company.

IBM United Kingdom, Ltd., has appointed Frederick Baillie as works manager of its Scottish plant, where, among other equipment, the IBM 650 computer is manufactured. Mr. Baillie joined IBM in 1955 becoming technical manager last year.

A correction.—In a note on page 172 of the April issue mention was made of a signal tracer and transistorized d.c. voltmeter made by Amos of Exeter. This equipment is handled by Soundrite, Ltd. (83, New Bond Street, London, W.1) and not by RGA Sound Services. It should also be pointed out that the title of RGA Sound Services was changed some months ago to CQ Audio, Ltd.

20th Century Electronics, Ltd., of New Addington, Surrey, recently signed a long-term agreement with Edgerton, Germeshausen and Grier, of Boston, Mass. It provides for the manufacture in Great Britain, under licence, of the E.G. & G. travelling-wave cathode-ray tube and the interchange of technical advice and "know-how." 20th Century is granted exclusive sales rights in the United Kingdom for the tube. Examples of the British manufactured tube were on show at the Physical Society Exhibition.

Rosite, Ltd., recently formed jointly by the Plessey Co. and Rostone Corp., of Indiana, has appointed B. W. Hymass as manager and J. G. Selby as sales manager. Mr. Hymass has been with Plessey's components division for 11 years and Mr. Selby was formerly sales manager of Insulators, Ltd. The company, which is operating from Cheney Manor, Swindon, is to manufacture a wide range of cold moulded plastics based on "Rosite," an inorganic plastic which has high heat resistance, arc resistance and dimensional stability at high temperatures.

Semiconductors, Ltd.—The transistor production equipment having been installed in the recently completed factory at Swindon, the sales and administrative staffs of Semiconductors Ltd. (a Plessey subsidiary) have moved from Ilford to the West Country. The new address is Cheney Manor, Swindon, Wilts. (Tel.: Swindon 6421.)

Ericsson-Solartron Agreement.—Under an agreement signed by the Solartron Electronic Group and Ericsson Telephones, Ltd., the distribution throughout the world of Ericsson electronic products will be handled by Solartron.

Garrard.—Within three days of the fire which destroyed Garrard's Swindon factory the first record changer came off the temporary assembly line erected in buildings put at their disposal by local industry.

Siemens Edison Swan installed radio-communication equipment and a direction finder in the 10,000-ton cargo vessel *North Devon* which was launched within 11½ weeks of the keel-laying and completed in about 24 weeks.

Antiference has introduced a free insurance scheme for owners of its aerials. It provides 12 months full cover against damage to property and/or aerial and third-party liability.

EXPORTS

An electronic digital computer has been ordered from Standard Telephones and Cables by the National Physical Research Laboratory of the South African Council for Scientific and Industrial Research. The "Stantec Zebra," as it is called, will be used to carry out calculations for pure and applied research problems in a variety of fields including nuclear physics and telecommunications.

Airport Radar.—Since their introduction, three years ago, of the world's first all-crystal-controlled 50-cm radar, Marconi's have received orders valued at well over £1M. Contracts have been placed for installations in many overseas countries and orders are in hand for installations at the Southern Air Traffic Control Centre (for London Airport), Gatwick, Elmdon and Jersey airports, and for Royal Aircraft Establishments.

Harbour Radar.—The Hamburg Harbour Commission has ordered Decca Radar for equipping Hamburg Harbour and the adjacent stretch of the River Elbe with four land-based radar stations. The contract has been awarded to Telefunken, G.m.b.H., in collaboration with Decca Radar, Ltd. The equipment to be used is of the same type as that recently installed by Decca at the Port of Southampton (see March issue) and shortly to be fitted at the Port of Liverpool.

Multichannel R/T Equipment.—A further order—making three in all—for multichannel radio-telephone equipment for the Azores inter-island communication system has been placed with Marconi's by the Portuguese Postal and Telegraph Authorities. Twelve sets of terminal equipment for the radio paths will be used in conjunction with carrier equipment manufactured by the Telephone Manufacturing Co.

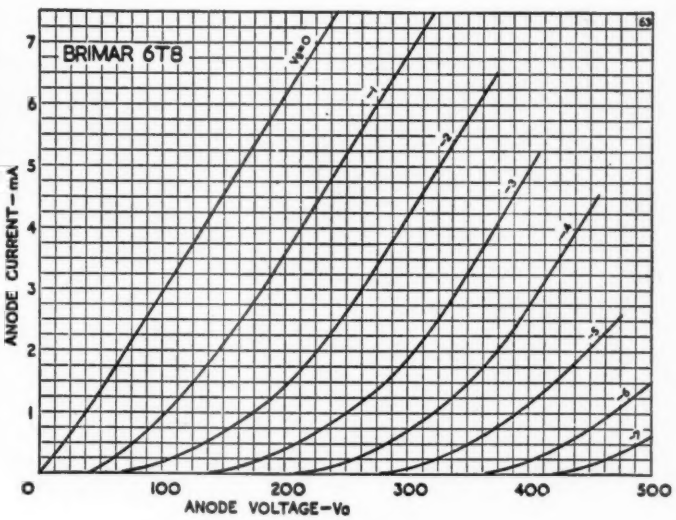
Nigeria.—A report on the market for domestic receivers, radio-gramophones and tape recorders prepared by the U.K. Trade Commissioner in Lagos, shows that the U.K.'s exports to Nigeria of sound receivers rose from £47,000 in 1954 to £218,000 in 1956 (the latest figures available). The total value of Nigeria's receiver imports for the years 1954 to 1956 was £141,000, £265,000 and £623,000 respectively. The Netherlands did not export receivers to Nigeria in 1954, but in 1955 the figure was £67,000 and in 1956 £253,000. Western Germany's figures were £70,000 (1954) and £146,000 (1956).

Ghana's imports of domestic receivers and the potentialities of the market are reviewed in a report prepared by the U.K. Trade Commission in Accra. The U.K.'s share of the country's £158,000-worth of imported receivers in 1955 was £61,000, Western Germany's was £54,000 and the Netherlands £39,000. Their figures for the first seven months of 1957, during which £230,000 worth was imported, are respectively £57,000, £47,000 and £109,000.

BRIMAR 6T8

TRIPLE DIODE TRIODE

The Brimar 6T8 is a triple-diode-triode in which one diode has a separate cathode. The triode section has a high amplification factor making the valve suitable for use in AM/FM receivers in the demodulation and first stage audio circuits. The diodes may be used in series shunt limiter circuits, for example, in the audio sections of television and communications receivers, followed again by the triode section for A.F. amplification.



Near Equivalents
EABC80
DH719
6AK8

Typical Triode Operating Characteristics as an R.C. coupled amplifier.

Heater Voltage		6.3 volts
Heater Current		0.45 amp.
Anode Supply Voltage	250	250 volts
Anode Load Resistor	0.25	0.25 megohms
Grid Resistor	1.0	10 megohms
Cathode Bias Resistor	3	0 kilohms
Peak Output Voltage	43	40 volts
Stage Gain (for 24 V peak to peak output) ...	42	42
Distortion (for 24 V peak to peak output) ...	1	5%

Cut this out for further reference or write to the Publicity Department at Footscray for a data sheet.

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Doh, *rah* and *me* look deceptively simple as musical notes. In reality they are complex little fellows, because the sound you want to hear includes a host of harmonics. Acos Series 65 turnover cartridges are notable for bringing notes to life, giving you faithful sound reproduction at a reasonable cost. Many well-known record players rely on Acos cartridges and there are different types for different applications. All have the famous Acos x 500 tested styli. It pays to look for the Acos tag on a cartridge.

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Physical Society's Exhibition

DEVELOPMENTS IN ELECTRONIC DEVICES AND TECHNIQUES

ONE of the chief attractions of the Physical Society's annual exhibition is its variety. Practically every known application of the electronic arts is represented, not only in commercially available measuring instruments but in research into such divergent interests as communications and agriculture, computation and medicine.

In the following pages a selection has been made of items which we think will interest our readers and also indicate the directions in which developments are moving.

Printed Circuit Techniques. The use of printed circuit techniques is becoming the rule rather than the exception. This trend is leading to some items with surprising performances—for instance G. V. Planer Ltd. were exhibiting printed potentiometer elements. Photographically reproduced with a meandered track of metal or oxide film, these potentiometers can have values up to 5MΩ, but with the characteristics of a wire-wound component.

A conventional multivibrator circuit on a printed panel was shown by the Morgan Crucible Co. (Morganite)—what was unconventional was that the board was operating in an oven at an ambient temperature of 150°C!

Another stand (Johnson, Matthey and Co. Ltd.) featured protective electroplating on printed circuit boards. Rhodium plating is used for switch contacts because it is extremely hard (Vickers' Penetration Number 800). Hard gold (V.P.N. 115) is used for less arduous duty on plug contact surfaces.

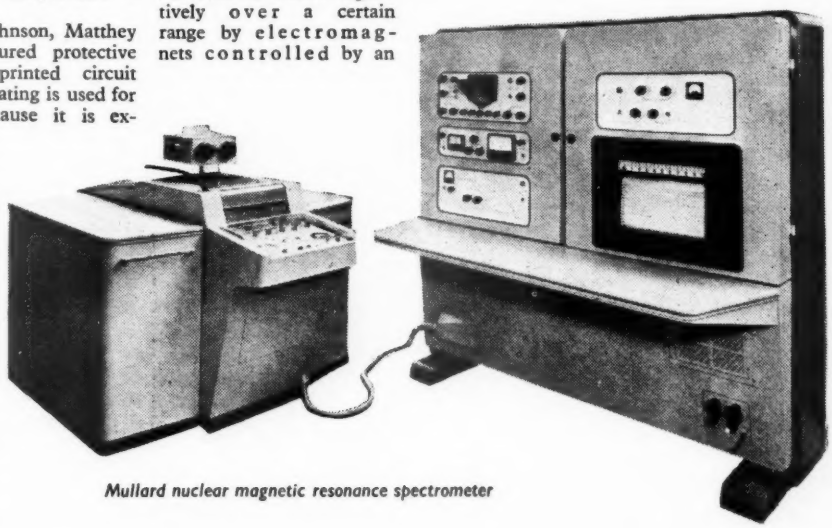
Magnetic Materials. The magnetic properties of the platinum-cobalt series have been known for some years, but the high cost has not made the use of these alloys an economic proposition. Now, as equipment shrinks even further, the limiting factors on miniaturization are often the basic physical properties of materials, and not cost.

Johnson, Matthey have developed a platinum-cobalt alloy giving a BH (max.) value of nearly twice and a coercive force of four times the values for Ticonal or Alnico V. The untreated material is completely malleable and ductile before heat treatment and can be worked by any suitable process.

Among the many ferrites at the exhibition were some samples made by an electrolytic precipitation process (G. V. Planer). It is claimed that the composition of the ferrite can be varied at will by altering the current to the precipitating electrodes, and that no milling or mixing of the precipitated material is necessary before sintering.

Nuclear Magnetic Resonance, in which spinning nuclei can be made to precess at characteristic frequencies by the application of magnetic fields, is the basis of a recording spectrometer for molecular structure analysis shown in commercial form by Mullard. The specimen for analysis is placed between the poles of a large permanent magnet (7,500 gauss) and the field is varied repetitively over a certain range by electromagnets controlled by an electronic sweep system. The resulting precession of the nuclei is observed by the absorption of energy at resonance in a small coil surrounding the sample which is energized at the precession frequency by a crystal-controlled r.f. oscillator. This absorption is detected by an r.f. bridge and the resulting signal passes eventually to a c.r.t. display whose timebase is locked to the sweep system varying the magnetic field.

Semiconductor Devices on view this year included several new junction diodes and transistors with interesting properties. G.E.C., for example, had a silicon p-n junction diode, type EW76, which exhibits a wide variation of junction capacitance with reverse voltage and can, therefore, be used as a variable reactance element. A change of 2-13pF can be obtained with a reverse bias range of 0-20 volts. A non-linear voltage/current characteristic is given by the SX640 silicon junction diode from the same firm. The voltage across the device is proportional to the logarithm of the current over five decades. In the switching and computing field, the 2N293 micro-alloy transistor exhibited by Semiconductors, offers great possibilities



Mullard nuclear magnetic resonance spectrometer

for high-speed operation. As an example, two of the transistors were shown working in an astable multivibrator at a p.r.f. of 10Mc/s, with rise and fall times of only 10 millimicroseconds (see April, 1958, issue, p. 189).

Semiconductor Transducers of indium antinomide for converting magnetic fields and infra-red radiation into electrical voltages were shown in commercial form by Plessey. The magnetic field detectors are based on the Hall effect and magneto-resistance effect respectively. They are particularly advantageous in applications where the detector has to be kept stationary relative to the field. The infra-red radiation detector is based on the photoelectromagnetic effect and was demonstrated in an apparatus for detecting low-temperature radiation like heat from the hand.

Semiconductor Multiplier based on the Hall effect in a plate of indium arsenide was demonstrated by B.T.H. The semiconductor is mounted in the gap of a ferrite pot core and the electrical signals to be multiplied are applied to an energizing coil in the pot core and to the polarizing electrodes on the indium arsenide plate. The open circuit output voltage across the Hall electrodes on the plate is the linear product of the two driving currents. Less than 1 per cent distortion is said to be obtained under maximum drive conditions. An interesting possible application of the multiplier is as a double-sideband carrier-suppressed modulator.

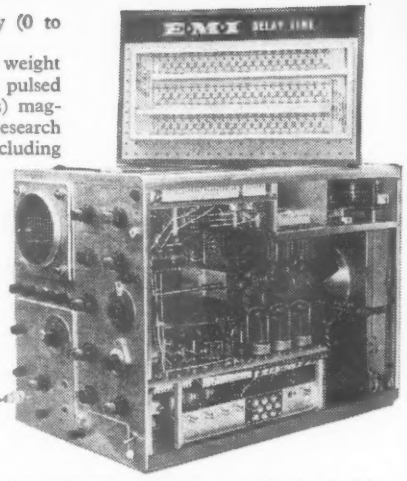
Microwave Components.—A probe carriage which can be quickly adapted for standing-wave measurement using slotted lines in any waveguide size from 12 to 20 (4 to 26kMc/s) was shown by Sanders. The high cost of a number of standing wave meters may thus be reduced to that of one such carriage and the slotted lines. Broadband coaxial mixers using a modification of the hybrid ring ("rat-race") with a potential 3 to 1 frequency bandwidth were shown by Mullard Research Laboratories.

A variety of facilities are available in a transistor battery standing-wave-ratio meter shown by Sanders. Crystal outputs from 1μV to 0.4V r.m.s. may be compared. The difference between two such signals may also be observed, this latter facility being useful in measuring small standing wave ratios using one fixed and one movable probe. Narrow band measurements may be made around 1 or 3kc/s. A bolometer input with built-in bias supply (0 to 10mA) is also available.

Microwave Valves.—The weight of an experimental miniature pulsed 200-watt S-band (2850 Mc/s) magnetron shown by Mullard Research Laboratories was only 3½oz including the associated magnet. The 2-kV, 1-A pulse input was obtained from a transistor modulator. A 500-c/s square-wave oscillator feeds a transformer to give an output of 2 kV. This is voltage doubled, rectified, and fed to a five-section line whose other end is matched to the magnetron. The 500 c/s oscillator also triggers a spark gap at the input end of the line so as to produce a discharge pulse which travels down the line, and whose voltage is shared between the magnetron and the line.

Frequency shifting of a microwave signal was illustrated by Mullard Research Laboratories. Phase modulation of the output of an LA9-3 X-Band (9000Mc/s) travelling wave tube by sawtooth or sine-wave modulation of the helix voltage was shown. With sine-wave modulation a number of sidebands are produced, at least 6dB down on the unmodulated signal. With sawtooth modulation, if the amplitude is such as to produce a maximum phase change of 2π, the fundamental and all sidebands but the lower first are almost entirely suppressed, as described by Cummings in *Proc. I.R.E.* for February 1957. Thus an almost pure shift in the frequency by an amount equal to the sawtooth frequency is obtained. Moreover, almost the full gain of the t.w.t. is still realized.

Oscillograph Tubes.—The general trend of development in instrument c.r. tubes is towards higher writing speeds and greater resolution. Tubes capable of displaying frequencies up to 500Mc/s are becoming almost commonplace nowadays and spot sizes of less than 0.001in are not unusual. Above 500Mc/s the transit time of the electron beam through the deflection plates is the limiting factor on frequency response, and it becomes necessary to use special techniques like the travelling-wave deflection system mentioned last year (June, 1957, issue, p. 283). A tube with a similar deflection system has been developed by 20th Century Electronics for photographic recording of millimicrosecond transients, and its travelling-wave system has an upper frequency limit of 3,000Mc/s.



E.M.I. W.M.7 oscilloscope with signal delay line (above).

Whereas the tube described last year had just a single helix for the travelling wave, the 20th Century tube is distinguished by a balanced pair of helices between which the electron beam passes. This gives greater deflection sensitivity and less defocusing of the spot by the deflection system.

Among the more conventional oscillograph tubes, the Ferranti type 5/63 is particularly interesting because of its high deflection sensitivity of 2.5 volts/cm (with 10kV on the anode) and a so-called "beam lever" electrode which can be used to vary the sensitivity over a 2:1 range by application of voltages between zero and a few hundred volts. Electronic Tubes were showing a low-consumption 3-inch tube for battery-operated portable oscilloscopes. The h.t. voltage required is only 1,000 volts, which can be obtained from a transistor d.c. converter, and the heater consumption has been reduced to 1 watt.

Transparent-Screen C.R.T. shown in experimental form by Ferranti has been developed for high-definition work in radar or television. The fluorescent screen is not applied to the face plate in powder form but evaporated on to it. Calcium tungstate is used as the phosphor because it enables the baking process necessary to diffuse the activator to be done at a lower temperature than with other materials. Apart from giving higher resolution (because of the finer grain of the evaporated phosphor) the transparent material makes it possible to apply a black backing to the screen. This does not reflect room illumination like the

usual white powder screens and so the contrast of the picture is greatly improved. The tube has a triode electron gun and operates with 20kV on the anode.

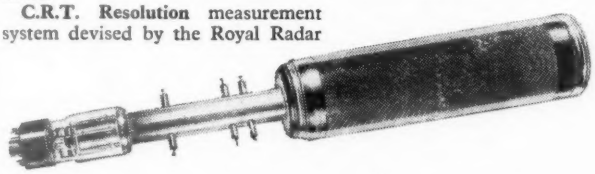
Two-Colour Radar Tube, also exhibited by Ferranti, has two phosphors, one of which lights up blue with relatively few sweeps of the spot while the other lights up magenta after a greater number of sweeps. This makes it possible to distinguish moving objects from fixed objects by colour differentiation. A fixed object produces continuous responses on a given piece of phosphor, which therefore lights up magenta, while a moving object only permits a few sweeps over a given piece of phosphor and, therefore, appears blue. The tube, type 6/61XM, also helps to distinguish between signal and noise by virtue of the repetitive nature of the signal.

Storage Viewing Tube, shown by English Electric, has its screen continuously energized by a "flood" beam passing through a dielectric mesh. A writing beam controls the surface potential of the mesh and so modulates the "flood" beam current reaching any part of the screen. A much higher luminous output can be obtained than from a conventional c.r. tube. The persistence of the trace can be varied from a fraction of a second to several minutes by applying a positive pulse of controlled duration to the metal supporting the mesh.

C.R.T. Resolution measurement system devised by the Royal Radar Establishment is based on a new parameter called "spatial frequency response." It avoids the uncertainties resulting from the common practice of specifying resolution in terms of spot size (arising from the spot's lack of sharply defined edges and unknown brightness distribution). The system actually measures the extent to which a tube can reproduce video signals applied as intensity modulation to a timebase. In this respect it is similar to the television practice of stating resolution in terms of so many lines. A 100-kc/s sine wave of constant amplitude is used to modulate the spot brightness, and the timebase speed is varied to give different numbers of intensity cycles along the trace—or different "spatial frequencies" as they are called. At each spatial frequency the amplitude of the light intensity cycles reproduced on the screen is measured by a photoelectric method and the results are plotted to give a curve similar to a frequency response characteristic. At zero and low spatial frequencies the geometry of the spot does not prevent the tube from showing the full amplitude of the light intensity cycles, and this condition is termed 100 per cent modulation. At higher spatial frequencies the spot size becomes significant in relation to the finer displayed patterns and the tube is increasingly unable to reproduce the full amplitude of the light intensity cycles. The amplitudes measured by the photoelectric system are therefore plotted as percentages of the full 100 per cent modulation. Typical curves, showing the effect of defocusing the spot, and details of the measurement apparatus, are given in "Technical Notebook," p. 239.

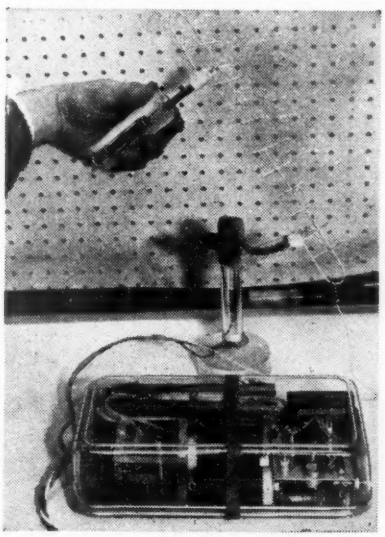
Oscilloscopes.—An instrument for use at lectures was shown by Rank-Cintel. For the convenience of the demonstrator, the back of the screen of the 12-in c.r.t. is visible through holes in the side of the cabinet, and the controls are placed at the rear. Switching between two inputs (cross-talk less than 0.5%) is possible, and their algebraic sum may also be shown. Full screen deflections are obtained with 8 and 13V peak-to-peak to the Y and X amplifiers respectively; the responses being flat within ±1 dB from 10c/s to 100kc/s. Sweep and trigger time bases are available.

A wide variety of sweep, trigger and measurement facilities are available in the new E.M.I. WM7 prototype. Either a squared graticule or calibrated deflection dials may be used to measure voltages and times to within ±2%. Triggering at frequencies up to 50Mc/s at a variable level is also possible. The X-sweep can be delayed from 1μs to 0.15s, with a jitter of less than one part in 20,000, to allow part of a complex



20th Century travelling-wave deflection c.r. tube.

Ferranti two-colour radar tube (left) and transparent-screen tube with black backing (right).



Mullard miniature S-band magnetron and modulator. The miniature Yagi aerials and neon indicator used for demonstrating transmission and reception are also shown.

waveform to be examined. The response of the d.c. Y-amplifier is 3dB down at 50Mc/s (rise time 8mμs) and its sensitivity is 100mV/cm.

A high d.c. sensitivity of 1mV/cm is a feature of the new Nagard J103 oscilloscope (prototype). The response is 3dB down at 1Mc/s.

Signal Generators.—A random low-frequency noise generator with a constant output down to d.c. was shown by Servomex (Type 77). The patented method uses a source giving a constant noise output in a high-frequency band which is narrow compared with its centre frequency. This band is filtered out, and all signals are limited (clipped) to a very low level. The resulting low-frequency difference intermodulation products give a constant noise output from d.c. to the frequency width of the band.

The full audio-frequency range from 20 c/s to 20 kc/s is covered in the single band of the Dawe 443. The tuning capacitor vanes have been shaped to give a logarithmic calibration, and the shaft extends at the rear for coupling to a motor drive and recorder.

A 13-channel and i.f. television alignment sweep generator (Type E5116) using a sawtooth modulated current to vary the magnetic field in the ferrite core of the oscillator coil was shown by Labgear. The tendency for the oscillator output to vary with the changing L to C ratio is compensated for. Crystal controlled narrow pulses to indicate vision and sound frequencies are also provided.

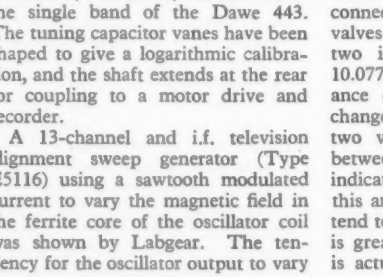
R, C and L Measurement.—Two-way switches in each of the probes allow selection of any of the 4 ranges up to 100 MΩ in the Rank-Cintel prototype resistance and insulation tester. An aural alarm indicates a short circuit between the probes.

Capacitance changes to within 0.05 pF in 200 pF may be measured with the Burndept BE 245 incremental capacity measuring instrument. If a signal is applied to the control grid of a frequency changer valve, and a parallel LC circuit tuned to this frequency connected to the signal grid, then a change in the tuned circuit capacity will cause a change in anode current in the valve. In the BE 245 a push-pull arrangement is used with the LC circuit connected to the signal grids of both valves and tuned to the mean of the two input frequencies of 10 and 10.077 Mc/s. In this way, capacitance changes cause anode current changes in opposite directions in the two valves, a voltmeter connected between their anodes being used to indicate any such changes. With this arrangement, drifts in the valves tend to act in opposition and stability is greatly improved. The voltmeter is actually used as a null indicator, capacity changes being backed off against a standard variable capacity.

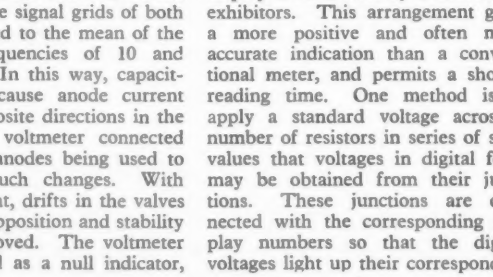
Comparison of resistances (from 0.25 Ω to 10 MΩ) capacities (from 2pF to 10μF) and inductances for (2mH to 100H) for component values differing by up to ±25% is possible using the British Physical Laboratories 1000-c/s CZ457 bridge. Phase angles may also be compared. For a 10% mains voltage fluctuation the indicated difference will not vary by more than 2%. The meter cannot be more than 20% overloaded using widely differing components.

An r.f. multi-ratio transformer arm admittance bridge (Type LE 300) was shown by Hatfield Instruments. Input frequencies from 15 kc/s to 15 Mc/s may be used.

Digital Voltmeters with a directly visible number (and sometimes sign) display were shown by a number of exhibitors. This arrangement gives a more positive and often more accurate indication than a conventional meter, and permits a shorter reading time. One method is to apply a standard voltage across a number of resistors in series of such values that voltages in digital form may be obtained from their junctions. These junctions are connected with the corresponding display numbers so that the digital voltages light up their corresponding

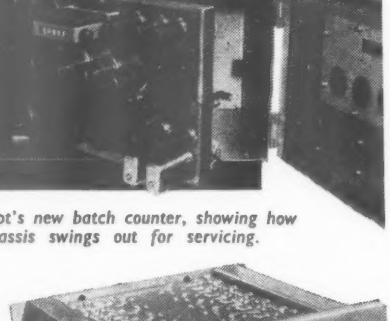


Torsional-wave wire acoustic delay line (Ferranti).



Burndept's new batch counter, showing how the chassis swings out for servicing.

Rear view of the "Langtrol" unit showing the power supply, oscillator, amplifier and range-and-balance sections.



Solartron electronic digital voltmeter.

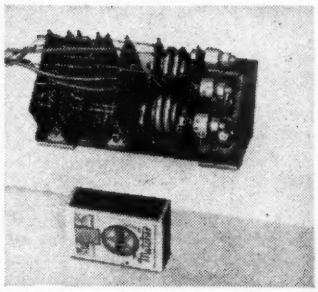
number. The unknown voltage is compared with the digital voltages in a suitable electronic switching sequence until a minimum or zero difference is obtained, the display number set up then being the nearest to the unknown number of volts. This was basically the arrangement used by Ferranti and Metropolitan-Vickers. A variant of this basic scheme is to obtain the digital voltages by switching a constant current into the various resistors as in the Solartron "Digicator."

A quite different system is used by Burndept on the other hand in their BE246. The unknown voltage is used to produce a field in the core of an inductance forming part of an oscillator tuned circuit. The resulting change in oscillator frequency is counted by a crystal counter and displayed on four Dekatron tubes.

Pulse Generators.—Fortiphone showed a miniaturized transistor airborn radar marker giving ten 80.8 kc/s spikes (representing one-mile intervals), followed by five 8.08 kc/s spikes, representing ten-mile intervals), all superimposed on an 800 μs pulse at a p.r.f. of 800/sec. The high output required (60V) was obtained by using silicon transistors. A very flexible two-pulse generator using 22 transistors was shown by Guy's Hospital Medical School. Independent control of the width and voltage of each pulse, the time between pulses, and the repetition period is possible.

In the versatile Rank-Cintel generator a multivibrator variable in frequency from 1 c/s to 1.1 Mc/s gives a fixed width and amplitude synchronizing pulse. This is also taken to a flip-flop to provide delay variable from 0.09 μs to 105 ms, and then to a second flip-flop to give a pulse whose width is also variable from 0.09 μs to 105 ms. This last pulse is used to provide three pulse outputs; rectangular or sawtooth of the same width, or two equal narrow pulses of opposite polarities corresponding to the rectangular leading and trailing edges, and obtained by reflection from a short-circuited cable.

Transistor Computing Circuits for digital operation were very much in evidence—no doubt heralding the appearance of complete transistor machines at subsequent exhibitions. Metropolitan-Vickers were demonstrating a system of logic based on a single-transistor circuit element or "building block" which could be reproduced cheaply in large quantities on printed-circuit boards. These basic elements on their small circuit boards are connected together into



Fortiphone miniature transistor radar marker generator.

computing arrangements by larger printed-circuits, and there are two further stages of connection, giving altogether a four-dimensional printed-circuit system, both electrically and mechanically. A similar system of transistor logic circuits on printed-circuit boards was shown by Mullard as part of an industrial sequence control equipment. A basic circuit provides "and" and "or" gates (according to the phase of the input signal) and can be converted into other logic elements by interconnection and addition of diodes.

Transistors also appeared in two other digital computing exhibits—a fast parallel multiplier shown by the Armament Research and Development Establishment and some torsional-wave acoustic delay lines on the Ferranti stand. In the multiplier the logic is performed by diodes and the transistors are used as interstage amplifiers. Similarly in the delay lines, the transistors provide the current pulses to the acoustic drive transducers (2mA, 1μsec) and amplify the signals from the pick-up transducers. The transducer used is actually a magnetostrictive type. It launches longitudinal stress waves in metal tapes which are coupled to the wire delay line so as to produce torsional waves in it. The particular advantages of torsional waves for this work are their low velocity and ability to preserve the separateness of input pulses at high repetition rates.

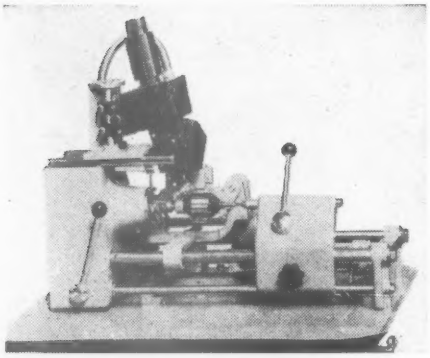
Counters and Timers.—Transistor models were shown by Venner and Rank-Cintel. When large numbers of valves or transistors must be used, the smaller heat dissipation and possibly greater reliability of transistors may be valuable. The use of transistors in the switching circuits required presents little difficulty. The cabinets of the Rank-Cintel units are made of fibreglass with slightly curved tops and sides, and an attractive three-toned colour scheme.

Magnetic recording electromyograph (St. Thomas's Hospital).

New Batch Counter. Burndept had some new and interesting equipment on view including a new batch counter suitable for use with a great variety of transducers. The whole unit is designed for ease of servicing and it provides all the usual facilities—variable paralysis, pre-end-of-batch pulse, end of batch pulse—and it can count at speeds up to 100,000 objects per minute.

Comprehensive Instrumentation. The "Langtrol" (Langham Thompson) transducer carrier system is a fully transistorized instrumentation system using a 3-kc/s carrier. It is made up from a number of units which can be combined to produce a single-or multi-channel equipment. The system will operate from 20 to 28 V, d.c.—rendering it suitable for aircraft use—or from the mains supply via a transistor-stabilized power unit. It produces an output sufficient to operate practically any recording system.

Radiosonde Telemetering System displayed by Rank-Cintel automatically measures and records the transmitted audio frequencies (representing temperature, pressure and humidity in sequence) by a counting and timing method. The a.f. signal from the ground receiver is frequency divided by 100 to give pulses which define time intervals, each containing 100 cycles of the incoming signal. These pulses are used to start and stop an electronic chronometer which measures the time occupied by the 100 cycles of



E.M.I. electronic dividing attachment fitted to a commutator undercutting machine. The light source and pick-up cell are mounted in the black assembly at the top of the picture and the servo amplifiers are located in the pedestal cabinet on which the machine bed is fitted.

audio signal and thereby, indirectly, the frequency. The "decade" information from the chronometer is then translated into the form of a voltage level on a step waveform, which is fed as a deflection voltage to a pen recorder. During one signal period (for a particular meteorological parameter) the counting and timing operation is done four or five times, and this produces a concentration of closely packed marks at a particular place on the recorder chart. The next signal period, for another meteorological parameter, produces a similar concentration elsewhere on the chart, and so on. The three parameters are therefore recorded by a sampling or time-division process on the chart, but the eye is nevertheless able to follow the broken line of each curve.

Medical Electronics.—Developments in recording systems for physiological data were noted in particular this year. An interesting feature of the electromyograph (for muscle potentials) shown by St. Thomas's Hospital, was a magnetic drum store for taking records of transient phenomena which would be too fast for the conventional pen writer. The oxide recording surface is actually on a removable plastic sheet which is wrapped round the drum and can be filed away for reference. It provides 19 tracks for recording, and the information is played back to a c.r. tube display system whose timebase is locked to the drum rotation.

The need for portability, and, in consequence, miniaturization, had obviously influenced the design of several other instruments. A miniature chart recorder on the Medical Research Council stand was small enough to be put in the pocket. The circular chart, driven by clockwork, is only about 2 inches across, and a miniature transistor d.c. amplifier is used in the self-balancing bridge type of servo for driving the recording stylus. The chart paper is of a kind directly sensitive to the contact of the metal stylus. In the Siemens Edison Swan transistorized cardiograph, another portable instrument, a hot-wire stylus records on heat-sensitive paper, which is driven by a battery-operated motor.

Mine Rescue.—When miners are trapped they can guide their rescuers by tapping on a pipe or rail. When these are not available reliance has to be placed on the longitudinal transmission of sound through a stratum, but the maximum range that can be achieved is very limited.

G.E.C., in co-operation with the National Coal Board have produced an underground listening set, consisting of geophones and a highly sensitive amplifier and indicating equipment, covering the frequency range 25 to 250c/s. Hammer taps have been detected up to ¼ mile away under very unfavourable conditions, but the range would be much greater if work noises were stopped. One of the main difficulties during development was to find valves of adequately low noise level over the unusual frequency range required.

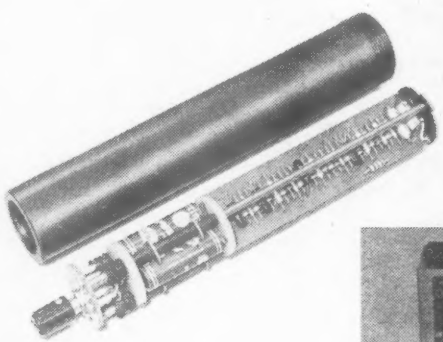
Transistorized Metal Locator.—Particularly notable for neat construction was the Rank-Cintel metal detector and cable route or pipe route tracer.

This small transistorized unit replaces the original valve amplifier/oscillator, and fits on to the search coil head as a handle. Once the pipe or cable has been found, the heavy search coil is discarded and replaced by a light ferrite-cored coil. The internal oscillator is switched off and the pipe is energized by a signal generator. The ferrite coil can then be used to trace the route of the pipe.

Vibration Measurement. A new application of the three terminal bridge technique was shown by Wayne-Kerr, as a vibration meter. Normal methods of vibration measurement require the attachment of a transducer or a stylus to the object under test. The Wayne-Kerr instrument uses a capacitive probe placed near the vibrating elements to control the feedback in an amplifier fed with a.c. from a high-impedance source. Thus the depth of modulation of the output from the amplifier is proportional to the vibration amplitude and is independent of probe spacing.

Ultrasonics. The Ultrasonoscope Company have produced some small probes for their flaw-detecting equipment primarily for use in situations where space is very limited, e.g., between turbine blades.

Ultrasonic frequencies have many uses in industry, but Mullard have added yet another—cold welding. The two metals to be joined are clamped together with not more than



Below: Miniature ultrasonic flaw detector probe (Ultrasonoscope).

Rank-Cintel transistor oscillator/receiver for the metal detector and cable or pipe route tracer (cover removed).

about 200lb pressure. The top "jaw" of the clamp is then vibrated in the "shear" direction at about 20kc/s by magneto-striction, producing a weld similar to a spot-weld. It is thought that the vibration breaks down the oxide film present on the surface of the metal, and once this has occurred small pressures are sufficient to cause fusion. Shear strength is about 80% of that of a spot weld, but Mullard hope to improve these figures.

Commutator Undercutter. The E.M.I. electronic dividing attachment was shown applied to a commutator undercutting machine. A narrow beam of light vibrates at 50c/s, shining on the commutator of the armature clamped to the machine. If the commutator is not centred properly the output from a photo-cell will be at 50c/s, because the light is shining alternately on to copper and dark mica. This causes a servo system to rotate the armature. When the mica is centred the light will shine on copper at either side, giving a 100c/s output from the cell. This locks the armature in position and starts the cutter. The machine will automatically undercut a 28 segment commutator in 35 seconds.

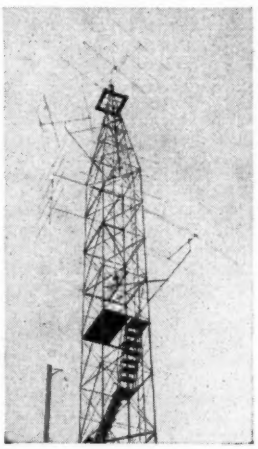
LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents

TV DX in Australia

I READ with interest the report by "Diallist" in the February issue of a South African's success in receiving the B.B.C. Crystal Palace TV service in his country and felt that my own efforts in long-distance TV may be of interest to your readers.

I have received the B.B.C. Ch. 1 sound on 25 occasions since Dec. 3rd last and the picture (snowy) on three occasions. I have five hours of recorded tape as a permanent record of this reception. Some of the tapes are already in the archives of the B.B.C. and reference to their Research Dept. (Mr. Dennis) will verify my claim to being the first person to see around the world by "looking-in" on the B.B.C., over a distance of some 11,000 miles. My success in seeing the B.B.C. TV film of the S.E. London rail crash on the 5th Dec. was widely reported in the world's press.



The top aerial on Mr. Palmer's tower was used for B.B.C. reception.

It is also reported that from time to time the American Police break through on British receivers. I have two such receivers here and experience the same reception of these Police calls from 42 to 46Mc/s over the 10,000 miles between Melbourne and U.S.

I trust my reports will be of interest to your readers.

Williamstown, Victoria, Australia. GEORGE F. PALMER.

Maritime V.H.F./F.M.

I REFER to the article in the March issue of *Wireless World* giving a report of the radar and v.h.f. control system for the Port of Southampton and to the statement (on p. 102) that it is believed that Southampton is the first port in England to use f.m./v.h.f. on the frequencies agreed at the Hague conference.

The Port of Dover brought into operation listening watches on f.m. 156.3, 156.6, 156.8 Mc/s at the beginning of January this year. These are in addition to the existing watches on a.m. at the same frequencies which have been in operation at this port since early in 1953.

The a.m. services will be continued at Dover until all the vessels normally using these ports have been changed to f.m.

Trusting this information will be of general use and interest.

Dover. B. A. A. SMYE-RUMSBY.

Valve Failures

AS A service engineer, I heartily endorse Mr. J. Spencer's remarks regarding premature valve failures, the replacements in television receivers under 12 months are reaching alarming proportions.

Although some of these failures are with new types of valves, there is one glaring example, a triode-pentode, used as a frame oscillator-cum-output stage, which has given persistent trouble over the last five years. This is one instance where a big improvement in reliability could be made, even if it meant an increase in the price of the receiver.

All service engineers, on behalf of their customers, would commend to manufacturers the slogan, "Reliability before Reductions."

Manchester. E. EVENSON.

Fixed or Free Stereophony

WITH reference to "Free Grid's" note (March issue) on the desirability of headphones for any foolproof stereophonic effect, I wholeheartedly agree. At present, it seems there are two main objections to the stereo systems now available:—

(1) The wretched listener has to sit rooted to the same spot all the time in order to get the full effect; this puts paid to listening to stereophony while doing odd jobs, minding the baby, etc. It is also extremely annoying having one's whole furnishing scheme subordinated to the positions of the two loudspeakers: in any case in the average living room there will be probably only one chair from which it is possible to receive the proper effect—hence there will be no question of all the family listening at once.

(2) "Free Grid's" objection, namely the necessity for each ear to hear only the channel meant for it. He suggests headphones—and this is an excellent idea as it also partly solves objection (1); the whole family can listen while seated in their accustomed chairs. There is still the problem of movement, as it is rather inconvenient doing housework with a long length of wire trailing behind, which headphones would obviously need.

One day, perhaps, it will be possible to have a battery high-fidelity radio receiver no bigger than the average

headphone; one could then buy two of them, clamp one to each ear and listen to the B.B.C.'s stereophonic* service (as doubtless it will be) wherever one liked, in the car, during a walk, or even in the bath (perhaps "Free Grid" will be interested!).

Fulmer, Bucks. J. R. P. BRIDGE.

* Binaural?—Ed.

Tape Speeds

ON considering "Free Grid's" understandable objection to the expression of tape speeds in inches per second and Mr. Davies' explanation of their origin, I agree that just to start with $1\frac{7}{8}$ in/sec as a new unit would not help. Evidently as techniques improve, still slower speeds will be used, when we shall be back to the fractions again.

I feel it would be more logical to use a logarithmic scale, analogous to the measurement of frequency in octaves above and below "middle C." The obvious zero for such a scale is the standard 30 in/sec, any other speed then being reckoned as n units representing 30×2^n in/sec. On this scale $1\frac{7}{8}$ in/sec becomes simply -4 units (the sign could be dropped, if not ambiguous). By definition all standard speeds can thus be represented by a simple integer, which I am sure would be no more puzzling than decibels.

Chelmsford. D. C. JEFFREY.

I HAVE been entertained by the discussion in your columns over the origin of tape speeds. I was particularly attracted to the idea of adjusting tape speed to the length of a possible broadcast programme.

However, whimsy apart, let us have on record a reason that is rather nearer the truth. We must accept that the development engineers who were responsible for the original Magnetophon were aware of the shortest recorded wavelength that the replay heads then available were capable of resolving. Simple sums would then show the tape speed necessary for the reproduction of the highest frequency required. From the known data this would have been in the region of 75 cm/sec.

Turn now to the workshops where the first machines were constructed. Any experimental machine shop carries a stock of steel rods ground to a high degree of accuracy and surface finish—known in this country as "silver steel" and in some other countries as "drill steel." A standard Continental size is 1cm diameter. Another normally available component would be a small induction motor having a shaft speed of about 1,450 r.p.m. on 50-c/s mains. Attach the standard shaft to the standard motor, and the speed is approximately correct for all practical purposes, with the great advantage that readily available materials could be used.*

With the adoption of standard speeds of 30 in/sec and sub-multiples, capstan shaft diameters have become rather more complicated. With the readily available induction motors with a shaft speed of 1,450 r.p.m., 30 in/sec requires a capstan diameter of 0.39514 inches, or if a synchronous motor is used at 1,500 r.p.m., a shaft diameter of 0.38197 inches will be needed.

Naturally, approximations are used, but oh! the complications of simplification and standardization!

NORMAN L. BOLLAND.

Farnham Common, Bucks.

* Easier said than done if the required concentricity is to be achieved without re-grinding the surface of the capstan.—Ed.

Tape Spools

ONE of the annoyances of this hobby is the way the last few turns unwind themselves off stored reels and produce crumpling of the tape. This could be very simply avoided by cutting four equally spaced slots about half an inch deep in each outside edge of the spool, and then placing a rubber band around the reel along the more suitable diameter. In this way any unwrapping beyond a quarter of a turn is prevented. Perhaps the manufacturers could pander to my laziness and make spools with such slots already cut in them.

Edgware. D. J. KIDD.

Forward Projection Television

I READ with interest the article "Forward Projection in the Home" by A. G. Tucker, in the March issue. He states in his first paragraph that he believes all receivers now marketed are rear projection models. My company has manufactured front-projection receivers for several years including suitable home models. The only drawback to the popularity of the latter, using screen sizes less than 4ft × 3ft, is the heavy purchase tax, which makes the price rather prohibitive.

I can endorse Mr. Tucker's remarks regarding the cinema quality picture obtainable using the activated screen with a reasonably low lighting level.

Merrow, Guildford. A. G. BASSETT, P.A.M., Limited

Optical Noise Filter

THERE seems to be some confusion on this subject arising from the fact that there is not one effect but a number of different effects. The improvements reported in your original note (October, 1957, "Technical Notebook") were reduction of noise, better contrast and better resolution. To these I would like to add a better sense of depth, though not for the same reason as Mr. Lindsley (February issue).

Resolution is fairly certainly due to the improvement in focusing on the retina brought about by the pin-hole camera effect. The eye is "stopped down" so that it has a large depth of focus. The reduction of extra-axial aberrations is not likely to be a significant factor, since the stopping down process limits the resolving power of the eye and you are unlikely to improve this beyond that of a good eye with no stop.

When a television picture lacks contrast it is usually because the blacks are not truly black but are dark grey. Now in order to be visible as grey they must produce an illumination level on the retina which is above the threshold level. When the pinhole is in front of the eye the illumination levels are all reduced proportionately, but now the areas which appeared as dark grey are below the threshold level and once more appear black. Hence the contrast of the picture is improved. A similar argument can be applied to the noise, and so perhaps instead of calling the pin-hole an optical filter we should call it an optical clipper.

There are several effects which contribute to our perception of depth, but one of these is the focusing of the eyes. When viewing a picture normally our eyes remain focused on the plane of the screen. With the increased depth of focus given by the pinhole our focus need no longer remain fixed and this freedom to change our focus helps the illusion of depth. It is true that we get a better impression of depth with one eye, but the use of pin-holes over both eyes does also improve depth, though not so markedly.

Brentwood, Essex. W. D. H. BLACKMAN.

New Book

Long-wave and Medium-wave Propagation, by H. E. Farrow, Grad.I.E.E. Based on a series of lectures to students in the B.B.C. Engineering Training Department specializing in the operation and maintenance of broadcast transmitting stations, this booklet discusses the problems of establishing a service area of adequate field strength, the effects of ionospheric reflection and ground-wave terrain and the use and limitations of synchronized group working. Pp. 39; Figs. 24. Price 4s 6d. Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

"BELLING-LEE"

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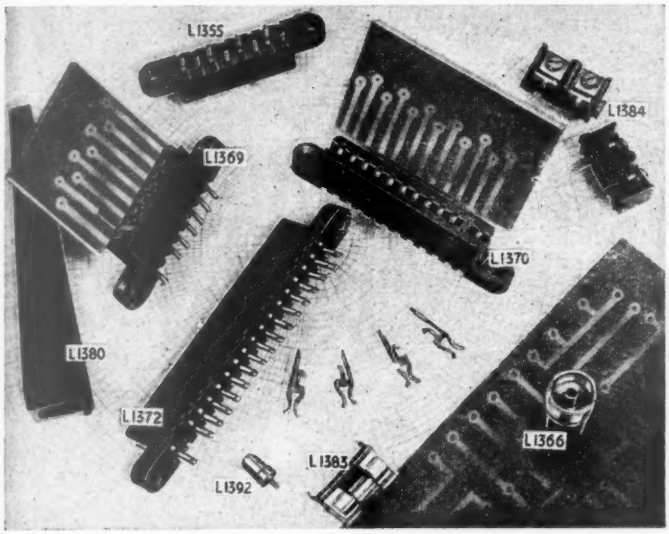

L.1369	8-pole connector 0.15in. module	L.1380	Printed circuit guide
L.1370	12-pole connector 0.15in. module	L.1381	Polarizing pin for connectors
L.1372	18-pole connector 0.15in. module	L.1366	Coaxial socket (accepts standard plugs)
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The new range of printed circuit connectors—first introduced at the R.E.C.M.F.—use the printed circuit board itself as the plug-in member.

The unique contact spring construction ensures that a very large number of insertions and withdrawals of the board can be made without deterioration of the circuit or connector. The springs are gold-plated to ensure a low resistance connection.

Correct polarity of insertion can be arranged by removing a contact and replacing it with a polarizing pin (L.1381) which engages with a slot cut in the panel. More than one polarizing pin may be used to " code " boards in an assembly.

All printed circuit components have been designed for dip-soldering and any holes in the base panel are on the 0.1in. grid, with the exception of types L.1369, L.1370 and L.1372 which are on a 0.025in. grid because of their 0.15in. spacing. For example, with L.1355 connector all holes, including those for fixing the connector and the guides (L.1380), are on the 0.1in. grid.

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"BELLING-LEE" NOTES

Chillerton Down, I.o.W.

By the time you are reading this, the I.T.A. pilot transmitter will be sending out a test card from Chillerton Down, Isle of Wight: the seventh site from which it has operated.

The four-stacked folded dipole array is already in position, it was designed and manufactured by " Belling-Lee " and is mounted on a " Belling-Lee " 75ft. " Skytower." We must make it clear that although we built and operated the transmitter for some time, it is no longer our responsibility, although we still have a great interest in its performance.

Its usefulness has been questioned, in our opinion unreasonably. Our " guestimate " of its range, conservative, yet based on experience, will be the coastal towns from Swanage round to Chichester or Littlehampton, including most places on Southampton Water, and part of the town of Southampton, remembering that places near docks often suffer from reflected images or ghosts. This estimate of the pilot transmitter cannot be taken as official, it is the personal opinion of the writer.

It must always be remembered that ground heights—hills and valleys are very important in assessing reception. If you are within the primary service area, on the side of a hill facing the transmitter and without a higher hill between, then you will probably receive a good picture without an elaborate aerial, but if you are on the other side, or at the bottom of the same hill, that is, backing on to the transmitter, then you will find you will have to exercise great care, and probably use quite elaborate aerials to get a picture of entertainment value. Always expect difficulties in river valleys—there will be places on the east side of the Avon, particularly north of Ringwood, where conditions might be tricky.

A primary service area is often described as " where most receivers, *unless they are situated in particularly unfavourable positions* should receive a consistently satisfactory service." We contend that viewers on the wrong side of hills or valleys are particularly unfavourably situated.

Ventnor, I.O.W., is well within the normal service area, but will have its own very real difficulties.

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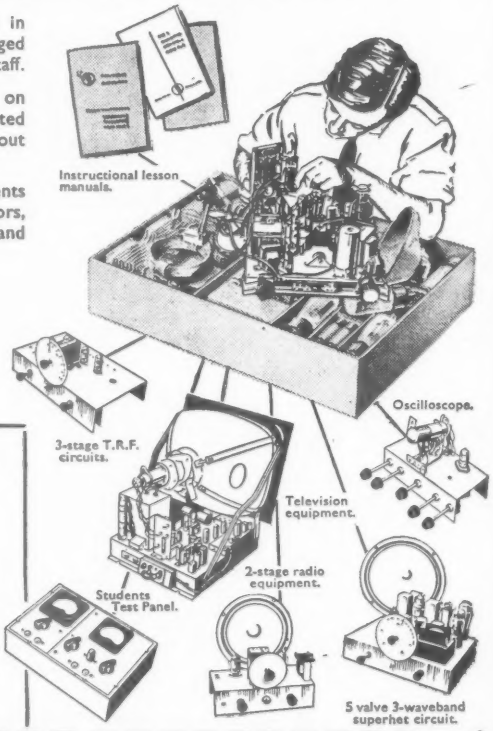

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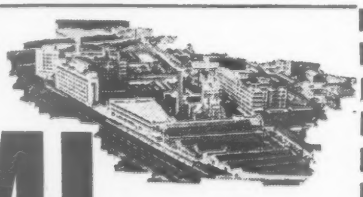

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Electron Energy Levels in Solids

By "CATHODE RAY"

LAST month we looked at some examples of the fact that the electrons belonging to an atom move around its nucleus in a way which can be represented pictorially only by a haze but which nevertheless follows strict rules. The most important rule is that only certain sizes and shapes of hazes are possible, and in each of these the electron possesses a certain total amount of energy. The amounts of energy are usually reckoned in electron-volts (eV), and are often displayed in diagrams such as Fig. 1, which shows the basic series of energy levels in the hydrogen atom. An electron normally settles into the lowest level possible (in Fig. 1, −13.5 eV), but can be lifted

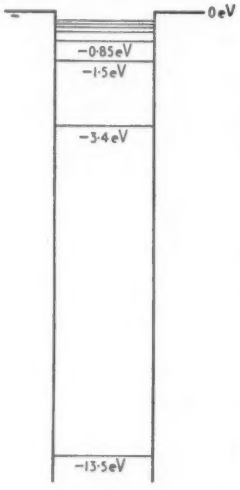

Fig. 1. In this "well" form of diagram are shown the possible energy levels in the "spherical" series of electron states of a hydrogen atom, which are terms in the series $-13.5/n^2$, n being any whole number. The negative sign is used because the most convenient zero level is the energy that parts the electron altogether from the nucleus. The actual energies are of course all positive, but the differences between the levels (which are what matter) are the same either way.

to a higher level by the arrival of the appropriate amount of energy from somewhere. It usually stays at the upper level for only a fraction of a microsecond (there are some exceptions) before dropping back and giving up the extra energy. Such energy is radiated as a "photon", and because the amount of energy in a photon is related to the frequency of the radiation by the quantum law ($E=hf$) in which h is a constant, the frequency f is completely determined by the amount of the energy jump, E. When E is large, the radiation comes into the frequency band of ultra-violet light or even X-rays; when less, visible light; and when very small it may be low enough to come into the radio band.

One of our examples was the upper atmosphere, where ultra-violet radiation from the sun imparts so much energy to the electrons that they are jerked entirely clear of their atoms. This process is known as ionization and is responsible for the reflection of waves which makes it possible to send radio signals around the earth. Another example was the energizing of gas molecules in glass tubes by shooting free electrons from end to end. The falling back from higher to lower levels produces the light we see from neon and other gas-discharging electric lighting. Sometimes only one important energy difference involved corresponds to a frequency within the visible band, so such light is concentrated mainly in one colour, depending on the particular gas used. This is all very well for drawing attention to the Palais de Danse, but not at all suitable as a substitute for daylight, which is distributed over the whole of the visible frequency band—roughly 400 to 800 MMc/s.

The elements we considered were chiefly gases, and especially hydrogen, which is by far the simplest because each neutral atom consists of only two components: the nucleus and one electron. Although atoms of gases other than hydrogen have more than one electron each, which makes their haze patterns and energy levels much more difficult to calculate, at least each atom is far enough away from all the others for their influence to be neglected. Consequently the possible energy levels are separate and sharply defined, as shown in Fig. 1; which means that the re-radiated frequencies are also separate and sharply defined and appear on spectrograms as mere lines. This state of affairs is sometimes likened to a single tuned circuit's resonance, which occurs sharply at an isolated frequency. A closer analogy is a cavity, which resonates in one harmonic series of frequencies lengthwise, another breadthwise, and so on.

When two circuits tuned to the same frequency are coupled closely together, their single resonant frequency splits into two, as can be demonstrated by over-coupling an i.f. transformer. In a somewhat similar way, when two atoms come close together so that all the particles in both attract or repel one another, it is found that single energy levels split into two. As with the tuned circuits, the width of separation increases with the closeness of coupling.

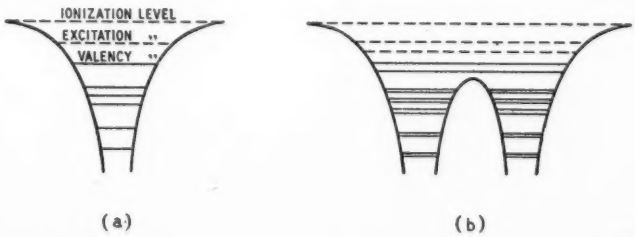

Fig. 2. Showing how the discrete energy levels of a single atom (a) are split into pairs when two atoms are brought close together (b).

This change can be illustrated by a modified form of energy-level diagram, in which the width increases towards the top to represent the greater distance from the nucleus. With this method, a single atom is shown as in Fig. 2(a). Those levels normally occupied by electrons are shown as continuous lines. Their vertical spacing is not to scale; the lower levels, especially, are much deeper down than they look in the diagram, but from now on we shall not be bothering much about those lower than the top occupied (or valency) level. The single excitation level shown stands for a large number of them into which electrons can be temporarily lifted by incoming energy. The ionization level is the point of no return, where an electron gains its freedom from the nucleus. Fig. 2(b) shows how each of the levels (except of course the last) splits into two when two atoms come close enough together to form a single unit—a molecule. The separation is least at the lowest levels, where electrons are influenced least by the component parts of the other atom. Note that at the valency level an electron is so screened off from its own nucleus by the other electrons that it may almost be regarded as belonging to the whole molecule, so this and higher levels are shown extending across both atoms.

Solids consist of vast numbers of atoms close together, so each of the single energy levels divides into a correspondingly vast number of energy levels, so close together that they form practically continuous bands. That is this month's key fact, illustrated in Fig. 3.

Most of the solids in which we are interested are crystalline; that is to say their atoms all line up in regular three-dimensional formation, at equal distances apart. A crystal can, in fact, be regarded as a gigantic molecule. Since it is the closeness with which the atoms are packed (the closeness of coupling, if you like) that decides how widely the single energy levels spread out into bands, the width of these bands depends on the type of crystal structure. Some substances are capable of more than one crystal structure, and these have different energy band patterns. Carbon is an outstanding example, as we shall see later.

Fluorescent Frequencies

One result of this band spreading is to provide a solution to our lighting problem, which was how to cover the visible band of frequencies as completely and uniformly as possible. Gas discharge tubes of the kind I have already described—usually containing mercury vapour, which radiates strongly on isolated frequencies in the visible blue and ultraviolet bands—are modified by lining them with crystalline materials chosen because their bands of radiation frequency cover the visible range with the desired balance (which may be "natural," "warm white," etc., according to taste). Such materials are described as fluorescent.

To go into all the why and wherefore of this broadening of the Fig. 1 line levels into bands would, as our American friends say, get us all snarled up (except those who are mathematically bright, and they can read a few books on the wave mechanics of solids). If you lack a mastery of this you may be puzzled, as I was, by one thing that explanations of fluorescent lighting usually omit to explain. We know that the "exciting" radiation from the gas discharge is at isolated frequencies—"discrete" is the proper word—and since it is in photons having only corresponding discrete quanta of energy it would appear that the fluorescent material could only be excited to levels that are higher by those particular amounts of energy. One cannot have a fraction of a photon left over. When the electrons drop back to their original state, the energy losses and therefore the frequencies of the fluorescence would be the same as those of the original discharge and one would be no better off. What we actually see is as unexpected as if people being pelted with shillings and half-crowns were to throw them back in the form of coins having every possible value from fourpence to ninepence in steps of a microfarthing.

The observed fact that the frequencies of re-radiation from fluorescent *solids* are lower (which means less energetic) than the frequencies exciting them is called Stokes' law.* The reason is very involved, but it seems that when electrons in solids are raised to higher energy levels the general interaction of the atoms leads to a rearrangement of electrons whereby the dropping-back jump is usually less than the jump up, and so the re-radiation frequencies are lower. The difference between the received and emitted energy appears as heat.

An alternative method of exciting fluorescence is by bombarding with electrons, as is done on television tube screens. Unlike a photon, which must give up the whole of its energy and then ceases to exist, a bombarding electron can give up any fraction of its kinetic energy, retaining the remainder in the speed with which it bounces off.

Fluorescence is rather a side issue, however, and we must get down to our main line of inquiry, which concerns solids in their less brilliant states. If you have been reading books about atoms you may have been perplexed by statements in some places that the energy of an electron in an atom depends entirely on the first number (n) in the four-part code indicating its state, whereas elsewhere it is said or implied that every state has a different energy. According to the first theory, the energy levels of the non-spherical states (in which the second code number is not zero) would have to coincide with the spherical-state levels shown in Fig. 1. Also there would be no difference in energy between the two directions of spin, indicated by the fourth number in the code. Yet on the other hand one reads that the electrons in an atom arrange themselves in order of energy, implying distinction between several that may have the same value of n. And most diagrams of the Fig. 1 type clearly show non-spherical levels

* Not the Stokes' law concerned with falling bodies.

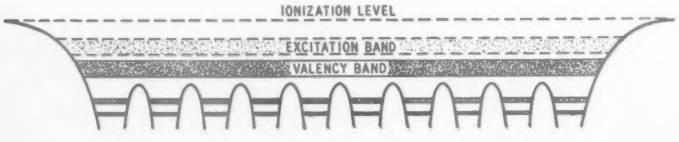

Fig. 3. In solids, enormous numbers of atoms (represented here by a mere ten) are close together, and the single energy levels are multiplied into practically continuous bands, of which those from the valency level upwards can be regarded as common to the whole piece.

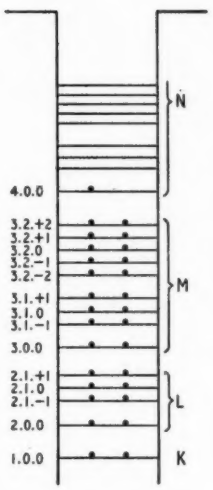

Fig. 4. Occupied energy levels (not to scale) in a single atom of copper at a low temperature. The markings on the left are the quantum numbers; on the right, the "shell" designations.

not coinciding with the spherical. Which is right?

The answer is that both are, but the first applies only where there is a single electron (as in the hydrogen atom), and in the absence of any magnetic field. Just as bringing a number of atoms close together splits up single energy levels, the proximity of a number of electrons in one atom separates out the energy levels of different states having the same n number. Likewise a magnetic field—such as the earth's—discriminates between the plus and minus values of the third code number. As regards electrons in the same state except for direction of spin, they can differ in energy in the presence of a magnetic field, but the difference is extremely small and for most purposes is neglected. So each energy level is usually regarded as capable of holding two oppositely spinning electrons.

It used to be supposed that at absolute zero temperature the electrons in atoms all had zero energy. But we have already noted that even the lowest level in Fig. 1, though negative with respect to the arbitrary zero, is really a positive energy—both potential and kinetic—and the single hydrogen electron can drop no lower, even at absolute zero. And because Pauli's principle invariably applies, there can be no more than two electrons at any one level. The helium atom has two electrons, which occupy practically equal levels lower than the lowest in Fig. 1, but still with some energy. The lithium atom has three electrons, so at its very lowest the third electron has to be up on the next floor (I didn't mention that each table in the atomic restaurant is on a different floor, did I? And that even at a single table some seats are higher than others?). The heavy atoms, with scores of electrons each, have correspondingly large numbers of occupied energy levels, and their restaurants would be quite tall buildings were it not that in order to agree with Fig. 1 we must imagine them to be entirely underground.

When I was introducing transistor theory in the July 1956 issue I simplified the matter by lumping all except the top-floor electrons along with the nucleus as the main body of the atom, in order to concentrate attention on these top electrons. Now, with Pauli's principle before us, we can see why this was possible. Fig. 4 is an energy level diagram (not to scale) of a single copper atom with its 29 electrons. The temperature being low and no other energy coming in, they are all bedded down in the lowest possible levels allowed by Pauli. Consider the position of those near the bottom. There are no vacancies nearer than the level half occupied by the topmost electron, so an extremely large quantum of energy would be needed to force them up past all the others. If such quanta were available—or even much smaller ones—they would find it relatively easy to disturb the much freer electrons near the top. The lone electron, especially, is screened off from nearly all the 29 units of positive attraction to the nucleus by the 28 units of negative repulsion from the other electrons, so its home ties are exceptionally weak. When only small quanta are about, insufficient to shift any of the 28, these 28 can be regarded along with the nucleus as fixed parts of the atom, as I said.

Fig. 4 applies to only a single atom of copper. That is of no practical interest to us, so we must consider a whole crystal of it—for copper has a crystalline structure, though this can usually only be seen by pulling a piece apart. Its energy level diagram should show as many levels for each one of those in Fig. 4 as there are atoms in the crystal. The innumerable "lone" electrons in the whole copper crystal are distributed over this broad band of levels.

In elementary explanations of electrical conductors and insulators we are told that conductors are substances which contain many electrons so loosely bound to their atoms that they can drift freely along in one direction under the influence of an electric field, whereas insulators have all their electrons tethered to their atoms so that no such continuous drift is possible. If you have been following this series through from the beginning you may already be suspecting that this explanation is a trifle over-simplified. For one thing, the voltage depth of the top electron in "well" diagrams does not differ enough as between one kind of atom and another to account for the enormous differences between their conductivities. (Copper conducts about 10^{22} times more than polythene.) If nobody even began to learn the first thing about electricity until he was an accomplished mathematician, the first lesson on electric currents would presumably be on a basis of wave mechanics and would differ considerably from the above. But since it is safer to assume that most people starting electricity not only are not accomplished mathematicians already but never will be at any time, the simpler approach is justified. As far as it goes, it is roughly correct. But if taken literally it fails to square in detail with the facts. So let us see where wave mechanics takes us.

A Different Picture

One of its main results, you will remember, was to replace the billiard-ball electron by a wave-function, and its precise orbit by a haze of probability. Being a haze, it has no clearly defined boundaries but just thins out as the distance from the nucleus increases. When atoms are massed together as in solids, their hazes merge, so that the outermost (valency) electrons, at least, can be regarded as belonging exclusively to no particular atom but free to circulate throughout the whole material, as suggested in Fig. 3. This is not at all the same thing as ionization, which necessitates sufficient energy being given to the electron to take it quite clear of its (or any other) atom. These circulating electrons are still some way "down the well," but the well represents the whole chunk of material. At the

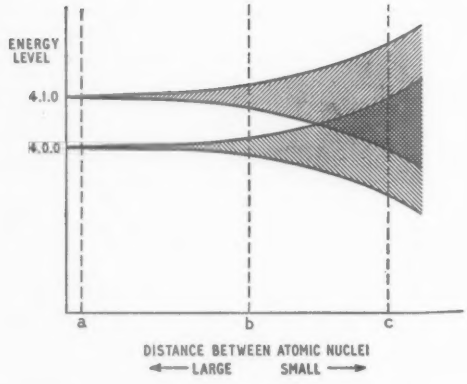

Fig. 5. Another way of showing how bringing very many atoms close together, as in solids, broadens the discrete energy levels (a) of the separate atoms into bands (b). If the spacing is close enough, bands may overlap (c).

low temperature we are assuming, the electrons have insufficient energy to escape from it.

This state of affairs is not an easy thing to visualize, and it will probably be worth while to pause a few minutes to think it out. One must be quite clear that the sort of diagrams we have been looking at refer only to energy levels, and not at all to the physical positions of electrons. Any one electron is visualized as circulating around the nucleus like a gnat, sometimes close to it, sometimes far (relatively!), but unlike the gnat not completely at random, for its energy is tied by the quantum laws to a fixed level. In the crystalline formation the nuclei are close enough together for it to be under the influence of more than one at a time, and it frequently (that is a masterly understatement!) transfers its prime allegiance from one to another. Owing to the "coupling" of all the atoms, all the electrons in any one state have very slightly different energy levels. One cubic centimetre of copper contains about 10^{23} atoms, and its energy diagram would have 10^{23} closely spaced levels, each with one electron, in place of the single 4.0.0 level and electron in Fig. 4.

Now this is the crux of the matter: Pauli's principle still holds; so no more than two electrons can occupy any one level. As we know, current flow through a conductor consists in electrons moving towards the positive pole of a source of e.m.f. For this to happen, the source has to impart energy to each electron. It cannot do so—and this is the thing that is not always realized—unless the electrons are capable of receiving small amounts of energy. Small, because with the voltages that can exist across conductive circuits the proportion available across the diameter of an atom is minute. It would be quite incapable of carrying an electron across gaps between energy levels such as those shown in Fig 4, which are of the order of a volt apart. But it can carry them up the almost imperceptible steps between the levels in an energy band —*provided that the upper step is vacant.*

In copper, only half the levels in the 4.0.0 band are filled; so, on the principle that "there is always room at the top," the electrons in this band are free to accept energy offered by even weak electric fields; which means that they can drift towards the positive pole, thereby creating an electric current.

If you still have the table of elements I gave away free with the last issue, you will no doubt be saying "Hi!" (or any loud cry) "What about zinc?" I take it that you are not referring to the minstrel tradition that this is the substance with which Sambo's mother's teeth were lined, but rather to the fact that its 4.0.0 levels are full up with two electrons each, so there is no vacancy in this band, and therefore according to the theory I have just outlined it ought to be a very good insulator. If such thoughts are indeed beginning to take shape it is time we looked at Fig. 5, which shows diagrammatically how the single energy levels of Fig. 4 (represented at *a*) broaden out into bands as the atoms are brought closer together. At *b* they are bands of some breadth, but still separated by gaps much too great for electrons to cross under the urge of any except enormously strong electric fields. If zinc atoms were so spaced, it would be an insulator, for all the levels in the 4.0.0 band would be full, while all the empty 4.1.0 levels would be out of reach. In fact, however, zinc crystallizes in a formation which spaces its atoms as shown at *c*, with the bands so broad that they overlap. Compared with copper, where bands also overlap, there are more electrons chasing fewer vacancies, a state of affairs which agrees with the fact that zinc is somewhat less conductive than copper.

The next three elements—gallium, germanium and arsenic—would plunge us straight into semiconductors, but before considering them it will be instructive to go back to No. 6, carbon, because it is a particularly interesting example. As you know, it is found fairly plentifully as graphite, which is black, soft, opaque and a fairly good conductor, and much less plentifully as diamonds, which are sparkling, superlatively hard, transparent and non-conductive. All this comes about because carbon crystallizes in two alternative formations; one (diamond) with the atoms so spaced that the nearest unfilled band is beyond the reach of the four outermost electrons; the other (graphite) in which the gap is much smaller. Even so, it is hardly small enough to be crossed by the gentle stimulus of an electric field, and we have to take into account another influence —heat. Since we have been ignoring it until now, we have in effect been assuming that our solids are at absolute zero temperature (−273°C), which isn't very realistic. The effects of heat are so important that we shall have to reserve next month's space for them.

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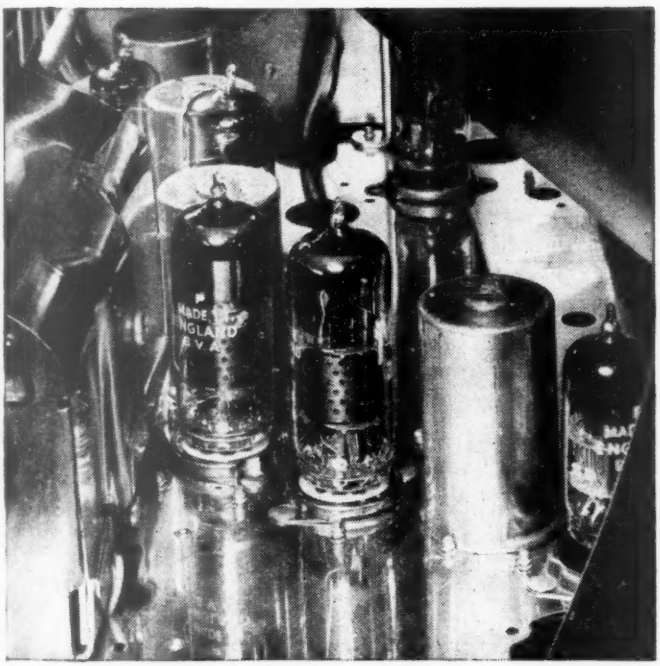

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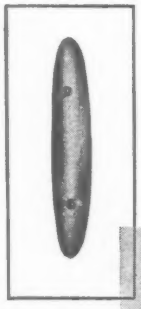

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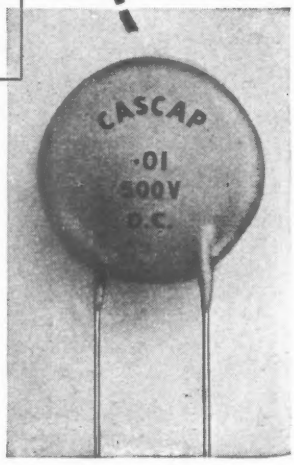

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Transistor Television Circuits

2.—Scan Output Stages, Video and Signal-Frequency Amplifiers

By J. N. BARRY*, M.Sc., and G. W. SECKER*

ALTHOUGH it should be possible to use a suitable power transistor in any one of the three amplifier configurations as a frame output stage in a television receiver, published designs[3] have used the common-collector or common-emitter arrangements. This choice appears to have been influenced by considerations of input impedance or available power gain.

It may be noted that when either of the preferred arrangements is used as a large signal amplifier, distortion may arise due to variation of current gain with emitter current.

In the case of the common-emitter arrangement using a p-n-p transistor, a further consideration in its use as a frame output stage is the polarity of the input sawtooth waveform. If a positive-going sawtooth input is used, the collector waveform will appear as a negative-going sawtooth and the excursion due to the frame flyback voltage will be such as to drive the collector to zero volts. or even to a positive potential. If this last-mentioned condition is reached the collector-base junction is biased in a low-resistance condition and the flyback pulse is clipped and lengthened. The transistor itself could be protected by the use of a " catching " diode, but the lengthening of the flyback pulse would still remain.

Alternatively, if a negative-going input is used, the flyback pulse will tend to drive the collector to a large negative potential (typically of the order of −70V) and the transistor selected must be capable of withstanding this voltage.

If an output transformer is used, any distortion of the output waveform due to variations in incremental permeability with changes in collector current will cause a form of distortion which will add to that produced by the changes in current gain with emitter current already mentioned. The effect of each form of distortion will be to cause cramping of the frame at the end of the scan.

A method of overcoming this form of distortion would be to peak the input sawtooth waveform. Referring back to Fig. 5 in Part I (April issue) it may be seen that the base voltage waveform (V_b) possesses the required characteristics.

It was found that this desired waveshape could be produced only across a high resistance load. In the final design, a common-collector buffer stage was interposed between the blocking oscillator and the output stage. This served to provide a power output sufficient to drive the output stage while at the same time presenting a suitably high value of resistance to the base circuit of the transistor blocking oscillator.

Measurements made on the frame deflection coils of the 17-inch receiver showed that, excluding the flyback pulse, a peak current of approximately 0.55 amps at a peak voltage of approximately 12V was required to scan the tube. Assuming a sawtooth waveform for voltage and current this represents a power input to the frame coils of approximately 2.2 watts[4]. It follows that the d.c. power input to the frame output stage must be of the order of 5 watts (assuming an efficiency of about 50%). In addition the output transistor must be capable of withstanding a collector dissipation of 5 watts should its driving signal fail.

The choice of the h.t. supply voltage applied to the frame output transistor is largely determined by the performance of the transistor itself. In particular, if the common-emitter circuit is used, the collector voltage excursion due to the amplified sawtooth waveform together with the flyback pulse should not exceed the voltage at which collector breakdown occurs.

If it were possible to increase the voltage applied to the output stage it follows that for a given power output the collector current could be reduced. This would have the effect of lessening distortion arising from current gain variations and also from the output transformer. The use of a common-base arrangement would to some extent allow this to be done but with the attendant disadvantages of a much lower input impedance and reduced power gain.

Complete Circuit

Fig. 9 shows the final arrangement of the frame output section together with the line oscillator circuit mentioned in Part I but adapted to work from an h.t. supply of −30V. In addition, a two-stage sync separator has been included to provide a positive-going line sync output and a negative-going frame sync output.

V_1 functions as a common-emitter type of separator with respect to line sync separation (as described in Part I) and positive-going line sync pulses of approximately 28V peak are developed across R_1. These are applied via C_4 to the base of the line oscillator, V_2. Negative-going frame sync pulses are developed across R_2 and C_2 in the emitter circuit of V_1 which is directly coupled to the emitter of V_2. This last-mentioned stage is biased fully on by means of the potentiometer R_4 and R_5 and serves to clip and amplify the frame sync pulses which then appear across R_3. (Since V_2 is used as a common-base amplifier no phase change takes place between input and output.) The frame sync pulses are applied

*Research Laboratories, General Electric Company.

[3] " Transistorized Vertical Deflection for Television Receivers," by M. B. Finkelstein, in " Transistors I " book (RCA Laboratories, 1956) p. 579

[4] " Reference Data for Radio Engineers " (Standard Telephones & Cables, 1948 impression).

to the base of the frame oscillator V_4 via C_5. The frame oscillator stage, while essentially similar to that described in Part I, has been modified to increase the curvature of the rise waveform of the sawtooth voltage appearing at the base. This voltage is approximately 5V peak-to-peak and is applied via C_{13} to the base of the buffer amplifier V_5. Being connected in the common-collector arrangement, V_5 presents a high impedance to the blocking oscillator and also provides sufficient current output to drive V_6, the frame output stage. Variation of the bias point of V_5 and V_6 by means of R_{14} introduces changes in the output waveform and affords a frame linearity control.

It may be mentioned that linearity adjustments tend to vary the voltage across C_{13} and if this component is an electrolytic capacitor some pulling of the frame oscillator can occur. This effect may be lessened considerably by using a tantalum electrolytic, the result then being comparable to that obtained by using a paper capacitor for C_{13}.

Negative feedback is applied to V_6 by means of R_{16} and R_{17}. The last-mentioned, being variable, acts as a gain control, and is used as the height control for the scan.

The h.t. supply voltage (−30V) was chosen as the maximum which could be safely used with available power transistors.

The output transformer T_3 was designed to have a step down ratio of 1.6 to 1 and used No. 4 Stalloy stampings with an air gap of 0.006in. This represents a suitable compromise between performance and physical size.

The total current consumption of the circuit shown in Fig. 9 was approximately 170mA. The consumption of the individual stages is given below, together with brief details of the transistors used.

The output transistor V_6 was mounted on a heat sink consisting of 6in × 6in of No. 18 s.w.g. copper sheet. No thermal run-away effects were noticed under no-signal conditions when the collector dissipation was approximately 4.5 watts. It may be mentioned that the use of negative feedback, i.e. R_{16} and R_{17} will contribute to the thermal stability of this stage*. The performance of the transistorized frame output section was considered subjectively to be comparable with that obtained from the 17-inch receiver in its original condition.

	Mean Collector Voltage	Mean Collector Current	Details
V_1	27V	0.2mA	GET4 p-n-p
V_2	0.5V	2mA	GET4 p-n-p
V_3	26V	0.6mA	2N98 n-p-n
V_4	25V	2mA	EW80 p-n-p
V_5	20V	4mA	Selected GET4† p-n-p high current gain
V_6	28V	160mA	GET9 p-n-p

Linearity measurements were made on Test Card C as described in Part I with the circuit shown in Fig. 9 incorporated in the receiver. The results were: line non-linearity 3%; frame non-linearity 9%. A photograph of the reproduced test card is shown in Fig. 10. The frame non-linearity was such as to produce a maximum height of a rectangle of Test Card C in the middle of the picture which diminished uniformly towards the top and the bottom. The linearity control could be used to extend either the top or the bottom of the picture at the expense of the other. There was a slight tendency towards loss of frame hold during adjustment of the linearity control, but, as

†A value of $\alpha_{cb} = 70$ was used in practice.

*For the component values given in Fig. 9 it can be shown by calculation[2] that the circuit will be thermally stable under the most adverse conditions up to an ambient temperature of 50°C provided the intrinsic thermal resistance of the power transistor $\theta \leqslant 18$°C/watt. This condition is fulfilled easily in practice.

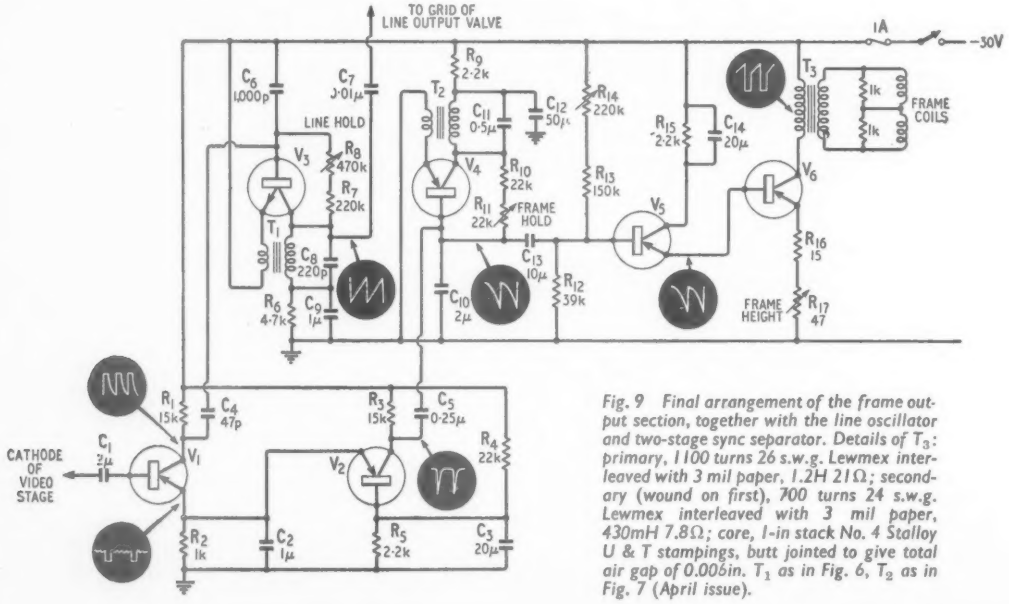


Fig. 9 Final arrangement of the frame output section, together with the line oscillator and two-stage sync separator. Details of T_3: primary, 1100 turns 26 s.w.g. Lewmex interleaved with 3 mil paper, 1.2H 21Ω; secondary (wound on first), 700 turns 24 s.w.g. Lewmex interleaved with 3 mil paper, 430mH 7.8Ω; core, 1-in stack No. 4 Stalloy U & T stampings, butt jointed to give total air gap of 0.006in. T_1 as in Fig. 6, T_2 as in Fig. 7 (April issue).

previously mentioned, this could be overcome by the use of a tantalum electrolytic or paper capacitor for C_{13}. The frame height control permitted a full scan to be obtained under all conditions of contrast and brightness.

In addition to the circuit functions just described, it is of interest to consider other possible uses of transistors in a typical television receiver. Such additional applications can be divided broadly into: (i) line timebase output stages and e.h.t. generators, (ii) video amplifiers, (iii) i.f. amplifiers, and (iv) r.f. amplifiers and local oscillator circuits. (Note: It is considered that the audio circuits have been discussed fully in previous publications, and are therefore not included here.)

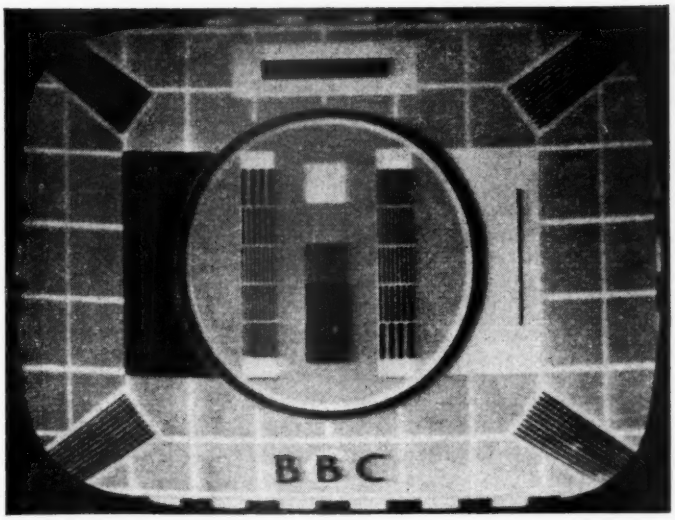


Fig. 10. Picture of Test Card C obtained with the Fig. 9 transistor circuits in the modified 17-inch receiver.

Line Output Stages.—If a conventional output stage is considered it is apparent that a number of circuit problems have to be overcome. A transistor in such a stage would be operating as a large-signal amplifier and would be required to feed the deflector coils via a suitable coupling transformer, i.e., a circuit based on the principles discussed earlier would be required. The transistor requirements in this case, however, would be more rigorous, and a medium-frequency high-power device having a high peak collector voltage rating would be required. The conventional output circuit using a thermionic valve is also used to provide the e.h.t. for the cathode-ray tube. It is doubtful whether the loading imposed by the e.h.t. circuit, together with the increased voltage and frequency requirements, could be supplied by a similar stage using transistors which are likely to be available in the near future.

A more hopeful solution might be in terms of an alternative circuit in which the transistor is in fact used as a switch directly coupled to the scanning coils. Circuits of this type have been described previously by Sziklai *et al.* [6, 7]. Basically the operation of these circuits is to utilize the magnetic energy stored in the scanning coils for part of a cycle to provide the scanning current for the remainder of the cycle. The former circuit[6] has the advantage of only passing part of the peak current through the transistor switch, but does require a large-amplitude initiating pulse. If such a circuit is also required to provide the e.h.t. voltage, a satisfactory solution to the problem again becomes very difficult because of the additional loading on the switch.

The simplest solution is probably in terms of a separate d.c. converter to provide the e.h.t. Such circuits have been discussed in some detail by Light and Hooker[8].

If the above problems could be solved satisfactorily it would mean that the timebase sections of the receiver, together with their associated circuits, could be fully transistorized.

Video Amplifiers.—In this and the following two sections, the operation of transistors in high frequency linear amplifiers is being considered, and the discussion assumes that alloy transistors, or developments of this type of device, are being used.

In order to achieve a video amplifier with satisfactory electrical performance using transistors, a bandwidth of 3 Mc/s is required, and the minimum gain to be provided is usually of the order of 30dB. In addition such an amplifier should provide an output voltage of the order of 50 volts peak-to-peak without distortion. Even if a video load as high as 5 kΩ can be used (this would require the total output capacitance, i.e. transistor collector capacitance plus strays, to be less than 10pF), the mean a.c. power in the load could be as high as 100mW. The transistor required for such an application, in addition to having adequate frequency performance and voltage rating, would thus need to have a minimum power dissipation of the order of 200mW at the highest ambient temperature encountered in the receiver.

It should be noted that the d.c. output power requirements may also need careful consideration.

Much of the original work on transistor wideband amplifiers was carried out by J. M. Early, who gives the relationship between "G_o", the maximum available power gain at low frequency, and "f_G", the frequency where the power gain is 3dB down on G_o, as :

$$G_o \cdot f_G^2 = \frac{f\alpha}{8\pi r_{bb'} \cdot C_c} \quad .. \quad .. \quad .. \quad (1)$$

[6] "Circuit Techniques Associated with Transistor Broadcast Receivers," Part II, by J. N. Barry. *Electronic Engineering*, October 1957, pp. 478-483.

[7] "A Study of Transistor Circuits for Television," by G. C. Sziklai, R. Lohman and G. Hertzog. *Proc. I.R.E.*, Vol. 41, 1953, p. 708.

[8] "Retrace Driven Deflection Circuit," by W. B. Guggi. *I.R.E. Transactions on Broadcast and Television Receivers*, No. 3, October 1956.

[8] "Transistor d.c. Converters," by L. H. Light and Prudence M. Hooker, *Proc. I.E.E.*, Vol. 102, Part B, No. 6, November, 1955.
See also "Transistor Power Supplied," by L. H. Light. *Wireless World*, December 1955.

where $f\alpha$ = alpha cut-off frequency (common-base connection).

$r_{bb'}$ = " extrinsic " or ohmic base resistance.

It can be seen from equation (1) that G_o is dependent on a factor M given by

$$M = \frac{f\alpha}{r_{bb'} \cdot C_c} \quad .. \quad .. \quad .. \quad .. \quad (2)$$

M is frequently referred to as a high frequency figure of merit for the transistor.

A simpler performance parameter is perhaps the maximum frequency at which the transistor will operate as an oscillator, denoted by f_{max}. This can be derived from the equation relating maximum power gain and frequency for the case of a tuned amplifier. This relation, which is valid over a limited frequency range (see next section), is given by:

$$G_{max} = \frac{1}{f^2} \cdot \frac{1}{8\pi} \cdot \frac{f\alpha}{r_{bb'} C_c} \quad .. \quad .. \quad (3)$$

The value of f_{max} is obtained by putting G_{max} equal to unity. Then:

$$f_{max}^2 = \frac{f\alpha}{8\pi r_{bb'} C_c} \quad .. \quad .. \quad .. \quad (4)$$

$$\text{Hence } M = 8\pi f_{max}^2 \quad .. \quad .. \quad .. \quad (5)$$

Substituting in equation (1):

$$G_o = \frac{f_{max}^2}{f_G^2} \quad .. \quad .. \quad .. \quad .. \quad (6)$$

As a general rule the value of f_{max} is found to be appreciably higher than the value of the alpha cut-off frequency $f\alpha$ (see Table I). It can be seen from the above equation (6) that in order to provide a gain of 30dB in a single stage amplifier having a cut-off frequency f_G of 3 Mc/s, a transistor having a value for f_{max} of the order of 95 Mc/s would be required.

Some recent work on cascaded common-emitter stages for use with video amplifiers has been published by Bruun.[9] This paper provides information for the design of an amplifier having an optimum gain-bandwidth product. With currently available transistors a two-stage video amplifier would probably be required for receiver applications, and the best technical solution is therefore not likely to be very economic.

I.F. Amplifiers—In a conventional receiver the i.f. amplifiers are required to operate on a frequency of approximately 34 Mc/s. For the types of transistor being considered, it has been shown by a number of workers that over a limited frequency range the variation of power gain with frequency obeys an inverse square law, according to equation (3). This relation is valid provided that the working frequency lies approximately within the range:

$$0.1 < f/f\alpha < 2 \quad .. \quad .. \quad .. \quad .. \quad (7)$$

By comparing equations (3) and (4), it is also seen that:

$$(G_{max})_f = \frac{f_{max}^2}{f^2} \quad .. \quad .. \quad .. \quad .. \quad (8)$$

From equation (8) it can be shown by way of example that for a power gain of 20dB at 34 Mc/s, f_{max} should be at least 340 Mc/s.

In order to see how far some of the above requirements are met by existing transistors, the typical characteristics of various high frequency types are listed in Table 1.

To meet the arbitrary performance outlined above, a transistor rather better than the 2N384 drift type appears to be required. This conclusion is based on the calculated value of f_{max} for this type.

It will be seen that Table 1 includes some types recently announced in America. It should be borne in mind that the characteristics of some of the devices as given in the table must be considered as tentative only, and may not necessarily appear as the characteristics of a production type in the future.

In addition to exhibiting the required frequency characteristics, transistors suitable for television i.f. amplifier applications should also have as low a value of collector capacitance as possible. If such values are appreciable the design of neutralizing circuits (which are likely to be necessary) may become difficult because of the need to take account of (a) spread in collector capacitance in production devices and (b) variations in h.t. voltage, particularly if battery portable receivers are being considered.

R.F. Amplifiers and Oscillators—Considering first the requirements for the local oscillator, it would appear at first sight that a transistor similar to the one specified for the i.f. amplifier stages ($f_{max} > 340$ Mc/s) would be suitable. However, considering the fact that the oscillator frequency must remain stable with variations in both temperature and supply voltage, it is likely that a transistor having a still higher value of f_{max} may be required. In some ways the problem is similar to that which has already been experienced with sound superhet receivers, but with the frequency range increased by two orders of magnitude.

The solution to the r.f. amplifier problem also requires a transistor having better high frequency characteristics than those specified in the preceding section (excepting possibly the experimental diffused base type), and appears to lie some way into the future, especially if a reasonable power gain is also demanded. In coming to these conclusions it is

TABLE I

Typical High Frequency Transistor Characteristics.

Type	$f\alpha$	$r_{bb'}$	C_c	$M = \frac{f\alpha^*}{r_{bb'} C_c}$	f_{max}‡
	Mc/s	ohms	pF		Mc/s
OC44†	15	110	10.5	13	23
OC45†	6	75	10.5	7.5	17.3
XA102†	8	75	13.5	8	18
EW65/2†	10	90	7.5	14.5	24.5
2N247† (experimental drift type)	35	40	1.7	520	140
2N384 (experimental drift type)	100	50	1.3	1,540	250
Diffused base type (experimental)	400	10	0.5	80,000	1,800

*The value of M is obtained by substituting $f\alpha$ in kc/s, $r_{bb'}$ in ohms and C_c in pF.

†Characteristics measured at $V_c = -6$ volts, $I_e = 1$mA, and are typical values.

‡f_{max} calculated from equation (4).

[9] "Common Emitter Transistor Video Amplifiers," by G. Bruun. *Proc. I.R.E.*, Vol. 44, November, 1956, pp. 1561-1572.

assumed that full coverage on Band III is required.

Future Possibilities.—It will be seen that certain functions in a television receiver, particularly the non-linear circuit applications, can now be solved technically in terms of transistors. However, since in domestic receiving equipment first cost is of paramount importance, it may well be some time before the use of transistors is introduced on the commercial market due to adverse economic considerations.

Another difficulty lies in the provision of suitable power supplies. Thus although some of the circuits described (e.g. sync separators) can be adapted to operate from the h.t. line of a normal mains receiver, other circuits, such as sound output and timebase output circuits, are likely to require the provision of special power supplies.

The use of transistors is likely to be more attractive if developments occur in the field of battery-operated portable television receivers. Should they do so, a situation similar to that existing at the present time with sound radio receivers is likely to arise, whereby the use of transistors is more or less restricted to battery-operated equipment. It also seems likely that, should there be a public demand for portable television receivers, an expanding effort would be devoted to solving the problems surrounding the r.f. and i.f. transistor circuits.

The most likely future development could well be a portable receiver having some of the circuits transistorized. Such a hybrid receiver could incorporate transistors in the timebase section and its associated circuits and use a transistor d.c. converter to provide the h.t. supply for the r.f. and i.f. valves.

In addition to possible uses in television receivers, a limited use of transistors in other types of television apparatus appears likely. Portable camera equipment is a typical example of such an application.

Sensitive Tuning Indicators

SOME PRACTICAL NOTES ON IMPROVING PERFORMANCE

By RICHARD OLIVER

THE well known "magic-eye" is designed to operate with fairly large changes of grid voltage (nine volts for one of the most sensitive—an average figure is about 15 volts). This is the order of voltage which is present on the a.g.c. line of the average radio receiver. A sensitivity of this order can be a disadvantage in situations where adequate control voltage is not available, such as the sound a.g.c. line of a television receiver where the amplifier valves have a grid base of six volts or so, or in an a.m. receiver using valves other than the conventional types, where the a.g.c. line does not become more than a few volts negative. When the "magic-eye" is used as a tuning indicator in an f.m. receiver it is necessary to peak the i.f. transformers at the centre of the passband to ensure an indication of correct tuning—this is an undesirable practice—and even then the change in pattern when first tuning to a station is large compared with the final change caused by the "hump" in the i.f. response curve.

Obviously, some means of increasing the sensitivity of the "magic-eye" is desirable. The practice of adding a cathode resistor, common to the cathode circuits of both the voltage amplifier and target section is well known, but this has its limitations. The control electrode in the display section controls, in the main, the distribution of the electron "beam" over the fluorescent target, but it also affects the current flowing through the display section, tending to reduce the potential difference between the control electrode and the cathode. Also the standing current in the display section backbiases the d.c. amplifier, causing a deflection. Thus there is a practical limit to the gain in sensitivity that can be achieved by this method.*

A moment's consideration will show that there are several points in the average receiver at which an amplified change of voltage of the correct polarity and magnitude for application to the control electrode exists, e.g. the screen grids of the amplifier

* It is suggested that the optimum value for the cathode resistor shown in Fig. 1 be determined experimentally.

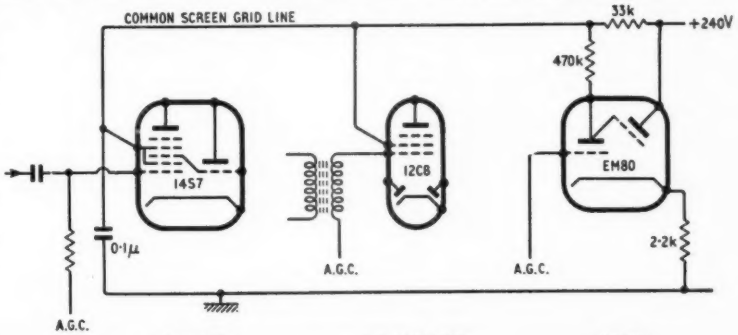


Fig. 1. "Sensitive" connection for the EM80 in an a.m. receiver

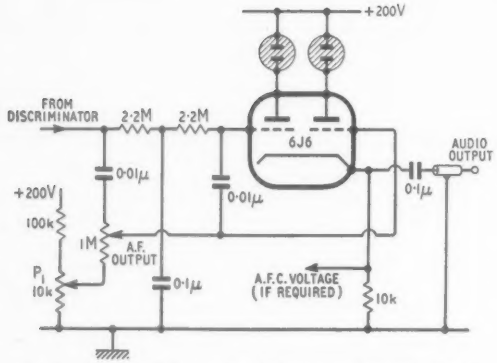


Fig. 2. Combined f.m. tuning indicator and output cathode follower.

or frequency changer (a.m. receiver); the r.f. amplifier screen-grid or the limiter anode (f.m. receiver).

If the voltage amplifier anode is returned, via its load resistor, to one of these points, the change of voltage will be "added" to that caused by the voltage amplifier incorporated in the "magic-eye," resulting in much improved sensitivity. In a particular a.m. receiver made by the writer (Fig. 1) an EM80 fully closes to two dark lines with a maximum of about 12 volts negative on the a.g.c. line. Connected in the conventional way this indicator requires a grid voltage change of 20 volts to produce a shadow angle approaching 0 degrees.

In an f.m. receiver the voltage rise at the anode of the limiter as the signal is tuned in is considerable. If this change is applied to the control electrode the change in shadow angle caused by it should be sufficient to provide an "approaching a station" indication. By delaying the negative voltage developed at the grid of the limiter before its application to the tuning indicator grid by an amount equal to the voltage obtained just away from the correct tuning point, i.e. on either side of the central "hump," the voltage at the tuning indicator grid is held constant until the correct tuning point is approached closely. When this occurs the change of tuning indicator grid voltage and the change of control electrode voltage act together to increase the sensitivity of the indicator at the point where a positive indication is required. Obviously the value of delay voltage required depends upon individual circumstances; therefore a circuit diagram with values is not given.

It is not generally necessary to allow for the voltage amplifier anode current when calculating the values of voltage dropping resistors, because this current is small compared with the other currents flowing in the circuit.

The second arrangement harks back to the f.m. tuning indicator described by John D. Collinson in the September 1955 issue of *Wireless World*, and used by the Acoustical Manufacturing Company in their "Quad" f.m. tuner.

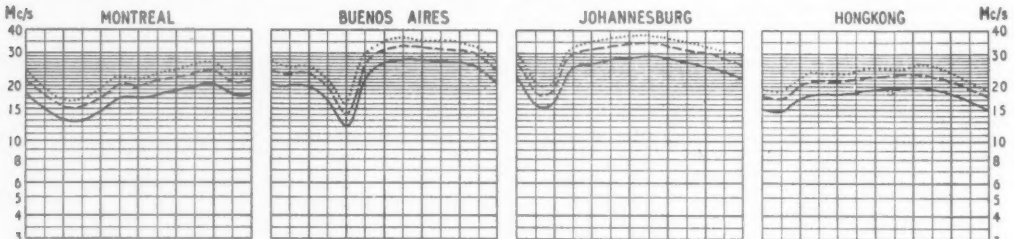
It occurred to the writer that to use a double triode for the tuning indicator alone was rather wasteful, especially when another triode is used as a cathode follower to feed the audio output cable. Therefore an effort was made to use the tuning indicator amplifier as the output cathode follower. The circuit shown in Fig. 2 is the result. The triodes run in parallel at a.f., but as a long-tailed pair for d.c. P_1 allows the light output from the neon lamps to be balanced. It may be necessary to bypass the slider of this potentiometer to chassis to avoid hum.

One word of warning—if the leads to the neon lamps are too long either of them may act as a relaxation oscillator when the current through it is reduced by detuning. This "howl" is possibly one of the best features of the modified circuit—it does prevent positively the fair sex using (or rather: misusing) the tuning knob as a volume control, and it is considerably cheaper than fitting a.f.c.

Incidentally—another feature of the circuit is that it is easy to use a back-biased germanium diode for a.f.c., because the diode can be biased by the positive voltage already present on the cathode of the tuning indicator amplifier-cum-cathode follower.

SHORT-WAVE CONDITIONS

Prediction for May



THE full curves given here indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during May.

Broken-line curves give the highest frequencies that will sustain a partial service throughout the same period.

•••••••••• FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE FOR 25% OF THE TOTAL TIME

— — — PREDICTED AVERAGE MAXIMUM USABLE FREQUENCY

——— FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE ON ALL UNDISTURBED DAYS

COMPANY MEETING

MARCONI'S WIRELESS TELEGRAPH
WORLD-WIDE ACHIEVEMENTS IN MANY FIELDS

SIR GEORGE H. NELSON'S REVIEW

The 60th Annual General Meeting of Marconi's Wireless Telegraph Company Limited was held on March 13th at Marconi House, Strand.

Sir George Nelson, Bart., Chairman, in his address said:

EXPANDING RESEARCH FACILITIES

For 60 years Marconi's have led the world in research into many of the aspects of radio and electronics which are now taken for granted, and with each year that passes we face new problems requiring apparatus of great complexity which must operate with impeccable reliability, often in confined spaces and exacting environments.

Since the war there has been a remarkable growth in both the size and scope of our Research activities. We have recently almost doubled the floor area of our Great Baddow laboratories to give us additional technical facilities.

We have made great progress in the many fields of microwave communication, including the " over-the-horizon " techniques known as Tropospheric and Ionospheric Scatter, which promise to revolutionise long-distance radio communication.

DOPPLER NAVIGATORS

In the aeronautical field, the outstanding event of the year concerned the Doppler Navigator, a revolutionary device to provide an accurate position anywhere in the world without having to rely on any ground-based aids. Our effort on this problem, in conjunction with the Ministry of Supply, has resulted in the Marconi Doppler Navigator which has been in operational service with the R.A.F. and some Commonwealth air forces now for more than three years.

RADAR FOR MANY PURPOSES

Our Radar Division continues to make its vital contribution to National Defence. The past year has also seen the development of a long-range airfield surveillance radar and of new techniques of remote display, making the operation of civil airlines ever more safe. On the naval side, your Company continues to contribute substantially to the Admiralty development and production programme for shipborne radar equipment.

MARCONI COMMUNICATIONS SYSTEMS

A Diamond Jubilee is always an event of importance, in our case not merely because our Company was the world's first radio manufacturer, but because during the 60 years since we founded this new science and industry we have surely made a unique contribution to the development of radio communications between people and places throughout the world. There are few countries indeed where Marconi telecommunications equipments are not in daily use.

While the range and variety of these equipments is very large, we have recently specialised in designing and installing entire multichannel radio communication systems to serve complete territories. We are at present surveying, planning or installing such communications systems in many countries of the world.

FURTHER EXPANSION IN TELEVISION

I now want to turn to two entirely different, but very important branches of our activities, television and sound broadcasting, in both of which your Company has a world-wide reputation, second to none, for the design and efficiency of its equipments. For well over a quarter of a century your Company has devoted a considerable proportion of its resources to develop the finest television equipment for the transmission of this modern entertainment medium. Since 1946, we have supplied for both home and overseas customers 70 transmitters, 33 aerial systems, equipment for 51 complete studio installations, 25 outside broadcast units, and over three million pounds worth of associated ancillary equipments. A proud record indeed. Your Company is today probably the largest exporter of capital television equipment in the world.

WORLD-WIDE DEMAND FOR SOUND BROADCASTING

The world demand for sound broadcasting continues to increase, even in countries which now have a large television audience. Our scientists and engineers are constantly striving for better and even more reliable equipment, though there are many Marconi broadcasters in the world which are still giving impeccable service after 25 years of almost continuous operation.

MARCONI INSTRUMENTS

It must be stressed that without efficient electronic instruments for testing and measuring purposes, few of the scientific and industrial achievements of our age could have come to pass. Without the aid of such instruments, much of our industrial life, much of our transport, our radio communications and television networks, much of the life of our hospitals—indeed, a very large section of our national life, would be severely handicapped, if not paralysed. Year by year, the range of Marconi instruments is enlarged to meet requirements in all fields of electronic measurement. Well over a hundred different types of Marconi instruments are now available, which combine precision and reliability with the highest operational convenience.

The Company is constantly adapting itself to the new and changing requirements of the electronic field, and new engineering groups have been formed to work on nuclear reactor instrumentation, guided weapon test equipment and instruments for use with radio multichannel link equipments. In hospitals and clinics everywhere, Marconi electro-medical and X-ray apparatus is helping to speed the progress of medicine.

I wish to end on a more personal note by recording our very sincere thanks to our Management, Staff and Works employees for their loyalty, enthusiam and hard work during the year.

The Report and Accounts were adopted.

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Direct-Coupled Transistor Audio Amplifier

By D. A. G. TAIT

SIMPLE AND ECONOMIC DESIGN

THE choice of an output stage for transistorized amplifiers and portable receivers would appear to be generally dictated by the requirements of battery economy and the limited power output capabilities of available transistors. In applications where these requirements do not hold, the use of a single class-A output stage with direct coupling throughout as in Fig. 1 is attractive, not least from the aspects of simplicity and component economy. That such direct connection of collector to succeeding base is possible was pointed out by A. R. Owens.* It is a result of the very low "knee" of the collector characteristic (especially when operating at low current levels) coupled with the need for bias in the following stage of the same polarity as the collector potential which bias may exceed the knee potential of the preceding stage.

Economical design demands that the standing collector current of a driver stage be as small as possible, but it must not be less than the base current of the following stage, to be able to fully drive that stage. Thus one would expect to find the ratio of standing collector currents in consecutive transistors to be equal to the current gain of the later stage. In these conditions, the base bias voltage of the later stage may be sufficiently greater than the knee of the driver stage to allow distortionless operation at high gain.

Design Procedure.—Having determined that direct coupling is feasible, the actual design procedure is quite simple. Operating conditions for the output stage are first determined, for example, on the lines indicated by W. T. Cocking† Having determined the output stage standing collector current, I_c, this is divided by the current gain, α'_3, to give the value of base bias current. Since the driver stage has to operate at this current level, the current in the feed resistor R_2 of Fig. 1 will be twice this figure. Thus $R_2 = V_b\alpha'_3/2I_c$, where V_b is the

* *Proc.I.E.E. Part B*, Nov. 1957, p. 583.
† *Wireless World*, March 1956, p. 109.

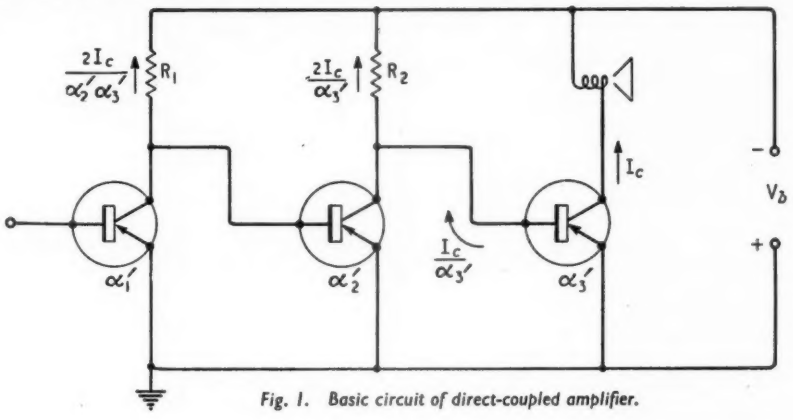


Fig. 1. Basic circuit of direct-coupled amplifier.

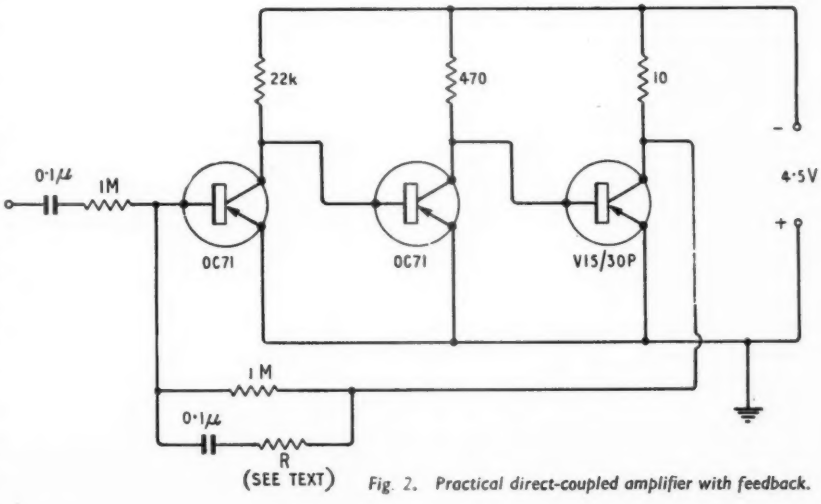


Fig. 2. Practical direct-coupled amplifier with feedback.

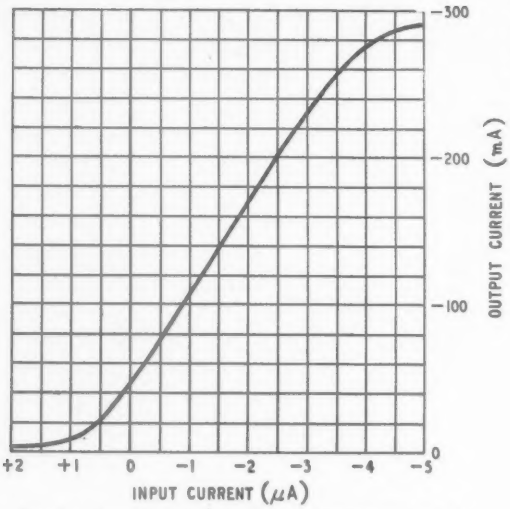


Fig. 3. Overall current transfer characteristic of the amplifier of Fig. 2 with no feedback.

supply voltage, and ignoring the small base-cum-collector to emitter voltage. The nearest lower preferred-value resistor is chosen.

The collector-cum-base feed resistor for the preceding stage (R_1) is then found by multiplying by α'_2 the value of R_2, and so on. This procedure cannot be carried on indefinitely, since after a few stages one would be demanding a current less than the leakage current, and the system would break down. Use of a battery in a feedback loop can allow operation below the leakage current by providing the necessary reverse bias; and the arrival of silicon transistors of extremely low leakage current may eventually allow extension of the principle to cover four or five stages.

A practical way to determine the value of feed resistors is to earth the base of the penultimate stage and adjust its collector resistor to give the designed peak current in the output stage; and then to earth the base of the preceding stage and adjust that collector's resistor for a minimum current in the output stage. The base bias for the first stage is then chosen to give the correct standing current in the output stage.

Performance.—Fig. 2 shows the complete circuit of an amplifier designed originally to give about 200mW in a speaker of 10Ω resistance, modified to allow measurements to be made using a 10Ω resistive load. The V15/30P output transistor is run very conservatively: with a higher supply voltage or lower speaker impedance, a much greater output power should be possible, the limit in this type of amplifier being set by the permissible current in the preceding OC71 (10mA). Fig. 3 gives the overall current transfer characteristic without feedback. The early turnover at 290mA is due to the battery potential falling to 3V at the high current level. The current gain is 64,000 times, or 96dB.

The curves of Fig. 4 give the frequency response for the following degrees of feedback:—

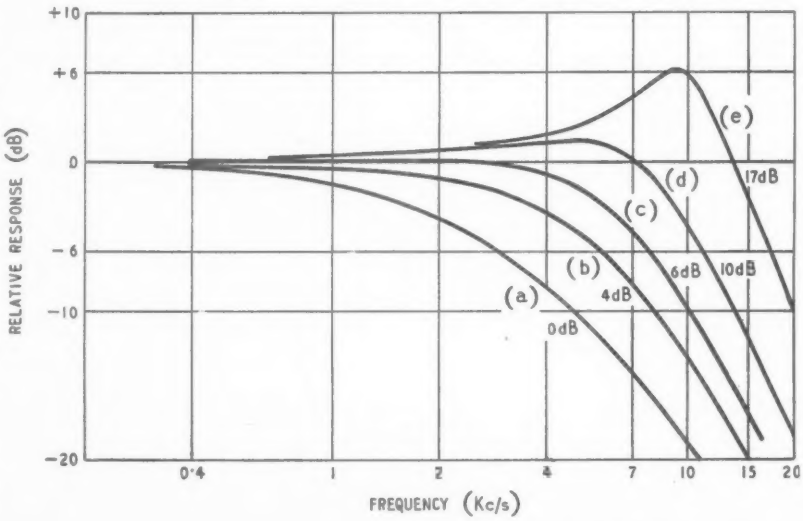
Curve (a) Feedback path broken.
„ (b) With d.c. feedback, equivalent to 4dB gain reduction.
„ (c) With R=1MΩ, equivalent to 6dB gain reduction.
„ (d) With R=330kΩ, equivalent to 10dB gain reduction.
„ (e) With R=100kΩ, equivalent to 17dB gain reduction.

Curve (c) could no doubt be improved by suitably phasing the feedback to give a substantially flat response to about 10kc/s. However, it should be appreciated that a moving coil loudspeaker load will modify the response due to its inductive impedance at high frequencies. Moreover, the power-handling capacity falls according to curve (a), since the design procedure inevitably results in the first stage being overloaded whenever the input is boosted at high frequencies to compensate for the fall in output.

Some degree of feedback should be applied to give good loudspeaker damping. The output impedance of the amplifier is given by the value of the feedback resistor divided by the unmodified current gain.

Advantages of direct coupling.—The economy in coupling components is obvious. Battery decoup-

Fig. 4. Frequency response of the amplifier of Fig. 2 with various amounts of feedback.



ling components also appear to be unnecessary, since any change in the base current to the output stage via its feed resistor (R_2) due to variations in the supply voltage is cancelled (at least at low frequencies) by the amplified current change in the opposite sense from the preceding feed resistor (R_1), when these two resistors are in the correct ratio. This argument is valid regardless of the source of any such changes in supply voltage; i.e., valid whether these changes are due to signal currents flowing through the internal impedance of the power supply, or due to ripple voltages in this supply. However, this argument does not apply if there is an odd number of feed resistors. Even in this case though, the situation is healthier than in a comparable capacity-coupled amplifier, due to the higher value of feed resistors used, and to the absence of low-frequency phase shifts. Furthermore, all the feed resistors are operating at virtually constant current at all signal frequencies, so that the output stage is the only one that can cause the appearance of signal voltages on the supply rail.

Since all but the output transistor are operated near the bottomed state, their collector dissipation is very low regardless of current level, and the maximum possible current in a stage is completely defined by the supply voltage and feed resistor.

Two disadvantages are apparent and have already been touched upon. First, the power handling capacity is a function of frequency; and secondly, an increase in leakage current in the first stage, for example due to an increase in the temperature, will restrict the available current swing in the output stage. Further possibly objectionable features arise when the amplifier is directly coupled to the speech coil of a speaker. The efficiency is reduced because of the d.c. power in the speech coil, and the speaker cone is displaced by the standing current. Of these disadvantages, only the temperature dependence of leakage current is likely to be troublesome, and some care will be necessary to ensure that the leakage current of the first stage does not exceed a small fraction of its operating current. It is worth noting that the three stage amplifier gives an overall d.c. phase reversal, being similar in this respect to a single transistor of very high current gain. Any of the accepted methods of stabilizing the operating point of a single transistor may be applied to the complete three stage amplifier with good results.

Application in Amplified a.g.c.—If the amplifier were adopted for use in a receiver, immediately following the detector, then, by direct coupling to this detector, the d.c. potential of the output stage could be used to control the gain of the radio-frequency amplifiers. By suitably biasing the gain-controlled stages, it should be possible to arrange for the gain to fall to an extremely low value when the collector potential of the output stage has fallen to its designed value. One would then have the interesting situation wherein the current of the output stage adjusts itself to the value required to handle 100% modulation of the received carrier. Thus there would be a measure of current economy, and it would be impossible to overload the amplifier!

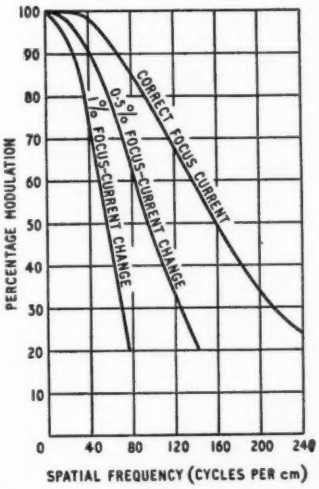
Technical Notebook

Tecnetron Mutual Conductance rising with increasing frequency is the most outstanding feature of the new French v.h.f. semiconductor device. The slope/frequency characteristic was given in our description of the Tecnetron in the March, 1958, issue (p. 132). This phenomenon results from the effect of the anode-cathode capacitance on the output current at high frequencies. Actually the equivalent circuit of the device is a resistance with capacitance uniformly distributed in parallel between anode and cathode. R and C are variable under the effect of the input voltage: the resistance diminishes as the capacitance increases, and *vice versa*. At d.c. and low frequencies the change of resistance is mainly responsible for the output current variation, but at high frequencies the capacitance change has the greatest influence. In a communication to the French Academy of Science (*Séances*, 246 (1), 6th January, 1958, pp. 72-73), M. Teszner, the inventor of the Tecnetron, gives a mathematical expression which shows how the current through the device is dependent on the frequency. The slope actually tends towards an upper limit which is independent of frequency. This is given by

$$s = \frac{dq}{dv}\, 2\pi\, f_c$$

where q is the charge of the anode-cathode capacitance; $v = V \sin \omega t$, the applied input voltage; and f_c is the "critical" frequency $\frac{1}{2}\pi RC$ (where RC is the time-constant of the charge of the capacitance). This upper limit of mutual conductance was suggested in the curve given in the March issue.

C.R.T. Resolution Measurement system described on page 221 is based on the extent to which a tube can reproduce video signals applied as intensity modulation to a horizontal timebase. The results are expressed in terms of "spatial frequency response" and a typical set of curves for a commercial tube is on the right. These show how the spatial frequency response (and hence the resolution) falls off when the spot is deliberately defocused. Incidentally, a spatial frequency of 50 cycles per centimetre corresponds to a modulation frequency of 3 Mc/s in a 405-line television system. In the R.R.E. measurement apparatus, a 100-kc/s signal is applied to the tube as intensity modulation and the timebase speed is varied to give different "spatial frequencies" (see p. 221). The phase of the 100-kc/s signal is advanced continuously with respect to the timebase by 30 cycles per second. As a result the modulation pattern drifts along the trace so that 30 cycles of the pattern pass a given point on the screen every second. An image of the trace is



formed across a narrow slit and light passing through the slit falls on a photocell, which produces an output pulse whenever the scanning spot crosses the strip of screen viewed by the slit. The photocell output pulses are amplitude modulated at 30 c/s to an extent proportional to the modulation of trace luminosity which is to be measured. This 30-c/s modulation is converted by conventional techniques to a direct voltage which is indicated by an output meter. When the spatial frequency is varied by altering the time-base velocity there is a change in the average density of current reaching the screen and hence in the trace brightness. This alters the amount of light reaching the photocell, so the whole measurement system has to be calibrated afresh at each spatial frequency.

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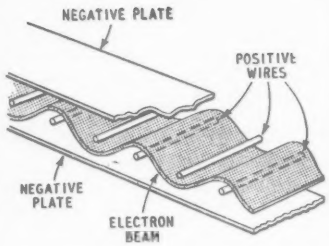

3.3 and 4.3kMc/s were readily obtained. However, in spite of the interlinking of the circuit by the electrons, the interaction between them is somewhat less than with a straight grazing but non-interlinking beam. Besides such use with travelling wave tubes, slalom focusing may also have applications in switching. This arises because if one of the wires is made negative, the current in the beam can be switched to one of the side plates by a very much smaller current in the wire. If the wire is made highly negative, the beam has been observed to double back upon itself, going under the wires it had previously gone over and vice versa. By continually shunting the beam to and fro in this way a storage device could be made. The storage time would, of course, be limited by defocusing of the beam due to collisions with the residual gas and possibly by space-charge effects.

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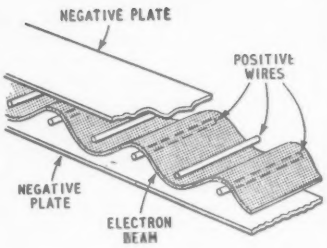

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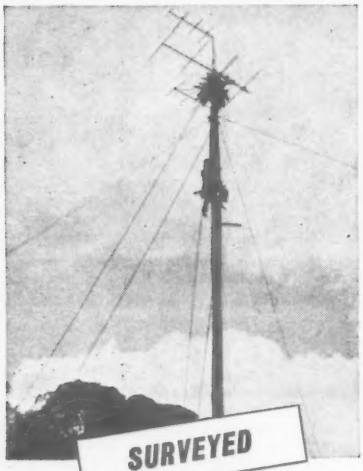

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By L. F. SHAW

MANY radio operators and experimenters believe that satisfactory radio communication on the amateur bands is only possible provided considerable power is used and it is not often realized that surprising results have been obtained with only a few milliwatts in the aerial. The user of low-powered, or QRP equipment, to use a familiar amateur expression, must be prepared to exercise great patience and not be discouraged by early failures to obtain replies to his CQ calls. So far no great distances have been covered by the small all-transistor transmitter described here for use on the 1.9-Mc/s (1600 metre) amateur band. Nevertheless on one occasion communication over 20 miles was effected with an input to the aerial of only 2.5mW and as the transmitter is capable of supplying considerably more r.f. power than this it is felt that much greater distances will be covered in time.

After several early attempts the transmitter described here, the circuit of which is shown in Fig. 1, was evolved. It employs three r.f. transistors, their function being: a variable frequency oscillator (v.f.o.) TR_1; a buffer amplifier and isolating stage TR_2 and a final amplifier, TR_3.

The VFO.—This employs a parallel-tuned Colpitt's circuit with C_1L_1 in the earthed-base configuration and in this form may appear a little strange to those more familiar with valve transmitting circuits. R_1R_2 is the base bias potential divider joined across the battery and C_3 is an r.f. bypass to the d.c. positive, or earthed, line. $C\,C_4$ is the conventional tapped capacitor network and is connected between the collector of TR_1 and earth with the emitter joined to the tapping (junction of C_4C_5).

Resistor R_3 is not a bias resistor as might be supposed but is part of the feedback and d.c. stabilization network of the circuit. L_1 is an Osmor QA4 aerial coil but only the winding with the single layer of enamelled wire is used, and it is tuned by C_1 which is one section of a Jackson Bros. miniature 365-pF two-gang variable capacitor.

The Buffer.—This stage has two main functions, (1) to serve as a reasonably high impedance output load for the v.f.o. (TR_1) and (2) as an isolating stage between the v.f.o. and the final amplifier (TR_3) to reduce "pulling" when the final is tuned, adjusted, modulated or keyed. The base resistors, R_4 R_5, are bias and stabilization components and it is desirable they be ±5% tolerance type. Elsewhere 20% tolerance components are permissible. The closer tolerance for R_4R_5 is to ensure that the optimum drive be applied to TR_3.

Final Amplifier.—In basic form this is a class B or C amplifier with R_9 and C_{10} pre-set to allow for adjustment to provide a constant output over the full frequency range of the band. They also serve as a means of suppressing spurious oscillations or "birdies" which may appear if the stage is operated with a d.c. supply much in excess of 5 volts. R_9 and C_{10} are primarily frequency-compensating, or linearizing, components and their adjustment must be a compromise between linearity and safe operation of the final amplifier, which is discussed later. J_1 is a miniature open-circuit telephone jack for plugging in a morse key, applying

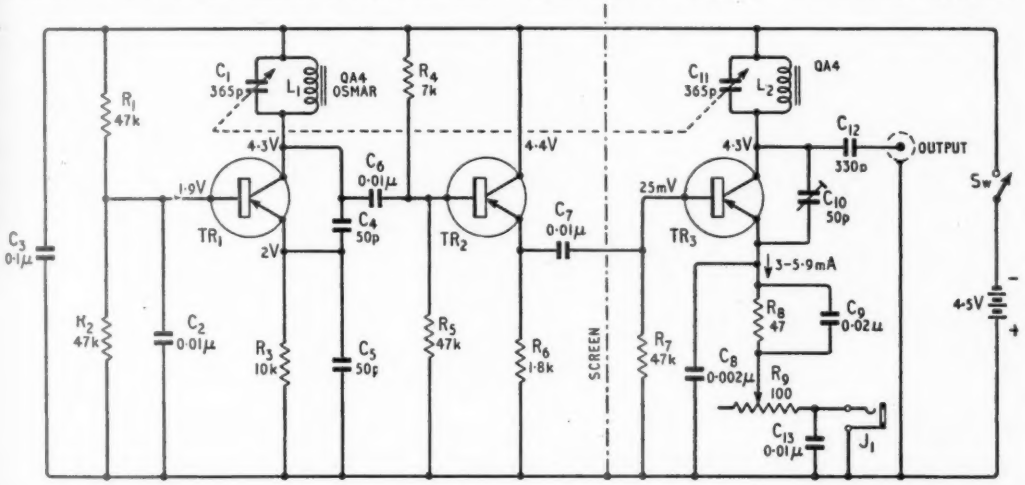


Fig. 1. Circuit of the transistor transmitter. Resistors can be ¼-W type and capacitors the lowest rating obtainable above 6 volts.

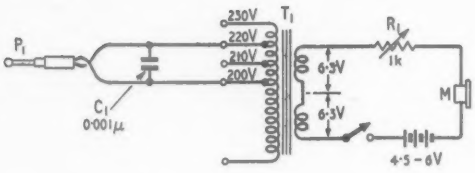


Fig. 2. Circuit of a simple R/T modulator for the transmitter.

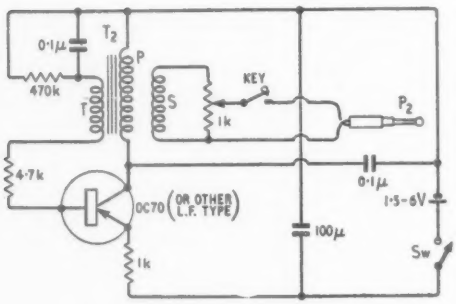


Fig. 3. Transistorized m.c.w. modulator for the transmitter. Details of the transformer T_2 are given in the text.

modulation or for metering the final amplifier. For the last-mentioned purpose a 0-10mA meter is satisfactory but it must be bypassed to r.f. with a capacitor of about 0.1μF.

Setting Up Adjustments.—With the tuning capacitor, C_1C_{11}, vanes about half meshed the dust core in L_1 is adjusted so that the v.f.o. is heard in a receiver tuned to 1.9Mc/s. With an aerial about 132ft long connected to the transmitter the dust core in L_2 is adjusted for maximum reading on a close-coupled field-strength meter or on an output meter. Some readjustment of the dust core in L_1 may be required while L_2 is being adjusted in order to achieve maximum r.f. output from TR_3. These

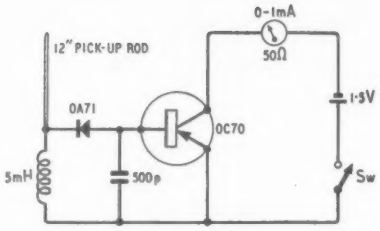


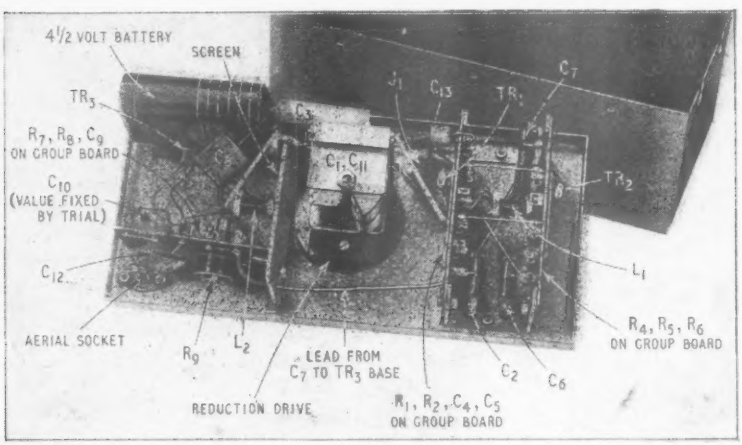
Fig. 4. A simple transistor field-strength meter can be made with this circuit.

adjustments must be carried out with a shorting plug in J_1, as measurement of emitter current for this purpose is likely to be misleading. After the circuits L_1C_1, L_2C_{11} have been correctly aligned the meter can then be plugged into J_1 and the emitter current noted. With the transistors used here this should fall between 3 and 5.9mA. R_9 and C_{10} provide the means for making adjustments to correct for excessive current and as previously explained for "birdies." During adjustments the output of the transmitter should be monitored on a suitably de-sensitized receiver with the beat oscillator on to check for a clean note.

Capacitive coupling via C_{12} is used for the aerial as this was found by experiment to be the most efficient method. No attempt was made to actually match the output stage to the aerial although on theoretical grounds this should improve the performance. Aerials of from 66ft to 132ft have been found satisfactory.

Modulation.—Either speech or tone modulation can be applied to the transmitter, but a separate unit, or units, are required as neither facility is embodied in the main equipment. The modulating circuit shown in Fig. 2 has been used for radio telephony and it consists merely of a high output-type carbon microphone M, a variable resistance R_1, to give a control of modulation depth, and a modulating transformer T_1. In the absence of a more suitable component a small mains transformer was used for T_1 by joining two 6.3-volt windings in series to form the primary (microphone winding) and using the 200- and 220-volt tappings on the original mains winding as the secondary.

An audio oscillator is required for tone modulation and this also can be transistorized and arranged as shown in Fig. 3. The transformer T_2 was wound on a small iron core about 1in cube with the primary (P) having 1,200 turns of No. 42 s.w.g. enamelled copper wire, the secondary (S) 300 turns of No. 40 s.w.g. enamelled wire and the tertiary (T) 100 turns



The transmitter is assembled on the lid of a metal box measuring 9in×7in×4in deep. The layout of the parts is clearly shown here. The tuning capacitor C_1C_{11} is insulated from the chassis.

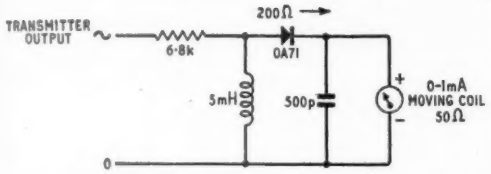


Fig. 5. Simple output meter for aligning the transistor transmitter.

of the No. 40 wire. A larger core could be used if more convenient, say the core of a small loudspeaker transformer, in which case heavier gauges of wire could, with advantage, be employed. The telephone plugs, P_1 for R/T or P_2 for m.c.w., plug into the jack J_1 on the transmitter according to which form of modulation is used.

Earlier in the description mention was made of field-strength and output meters for adjusting the transmitter. The field-strength meter used was also transistorized and its circuit is given in Fig. 4. It is self-explanatory and the same can be said of the circuit of the simple output meter, which is shown in Fig. 5.

Notes.—Sometimes a little frequency modulation of a non-crystal-stabilized transmitter results when the output stage is amplitude modulated, especially by speech. Should it occur in the present transmitter and be found troublesome it can be reduced to negligible proportions by reducing R_4 (Fig. 1) to 47kΩ and increasing R_6 to 10kΩ. These changes unfortunately reflect adversely on the performance of the transmitter and the r.f. output is reduced from about 12mW with the original values to between 2 and 3mW with the amended ones. Compromise values for R_4 and R_6 would, however, enable a reasonably good output to be obtained without too much frequency modulation appearing. Only experiment can decide which values will be best for these two components if changes have to be made from the original.

The actual transistors used by the writer were metal-cased ones having one red and one yellow spot on the top. The actual type is unknown but the characteristics are briefly:—collector voltage 5V; power dissipation 20mW; collector current 10mA; emitter current 10mA; frequency cut off 2.5Mc/s minimum, 3.5Mc/s average specimen. The red spot identifies the emitter and the yellow spot the collector. They are obtainable from Lasky's Radio and from Home Radio of Mitcham and possibly other firms as well. Several Mullard OC72s have been tried and found to be excellent oscillators in the circuit of Fig. 1. Out of 15 all oscillated above 1.6Mc/s with the majority reaching 2.5Mc/s and some even higher.

B.B.C. TELEVISION CENTRE

As can be seen from this aerial photograph, construction of the B.B.C. Television Centre on the old White City exhibition site is well under way. The White City Stadium (top right) gives some idea of the area covered by the Centre. There will be seven studios in the outer ring of the building, the first four being brought into service in 1961. All the studios will be linked by an internal 20ft wide runway along which scenery, etc., will be conveyed from the scenery block (left), which is already in use. Two floors of the main administrative circular block in the centre will house the engineering equipment. The studio control rooms will look down from this circular block into the studios radiating from it. The Centre will house the national central control room and also the Continental control point for Eurovision at present in Broadcasting House. The garden in the central ring will be 150 feet in diameter—about the size of Piccadilly Circus.

The Band V convertor assembled as a self-contained, screened unit, including power supply.

U.H.F. Convertor with Signal Frequency Amplification

By H. N. GANT,* A.M.Brit.I.R.E.

Television Reception on Band V

As mentioned in the article on Band V tests in *Wireless World* for December 1957 (p. 566) experiments are being conducted to ascertain the possibilities of this band, using different television systems and types of receiver. For this purpose the B.B.C. are transmitting signals from their station at Crystal Palace and the reception at various places is being assessed. Some of the receivers, however, are of a type unsuitable for ordinary domestic use at present.

One of the principal problems facing the designer of a television receiver for use at u.h.f. is the noise factor. In the U.S.A., where this band is already in use for television broadcasting, it is common practice to use no amplification at u.h.f., the signal being fed directly into a crystal diode mixer. The local oscillations are often derived from a harmonic of the existing v.h.f. (Band III) oscillator. This yields a noise factor of some 18 to 20dB at 650 Mc/s owing to the conversion loss in the crystal and the presence of noise sidebands with the oscillator harmonics. It is, however, neat and cheap since the entire unit can be built on to one position of an orthodox television turret tuner.

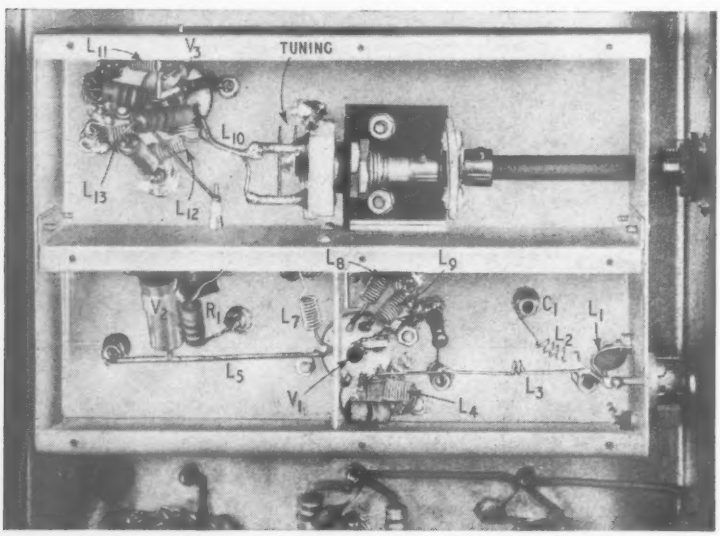
The use of Lecher lines or resonant cavities for the u.h.f. circuits, and a separate u.h.f. oscillator, would give an improvement in the noise factor of 16 to 18dB. Experimental models have been described which are much better than this, down to 10 to 11dB, but these are not in commercial use at present.

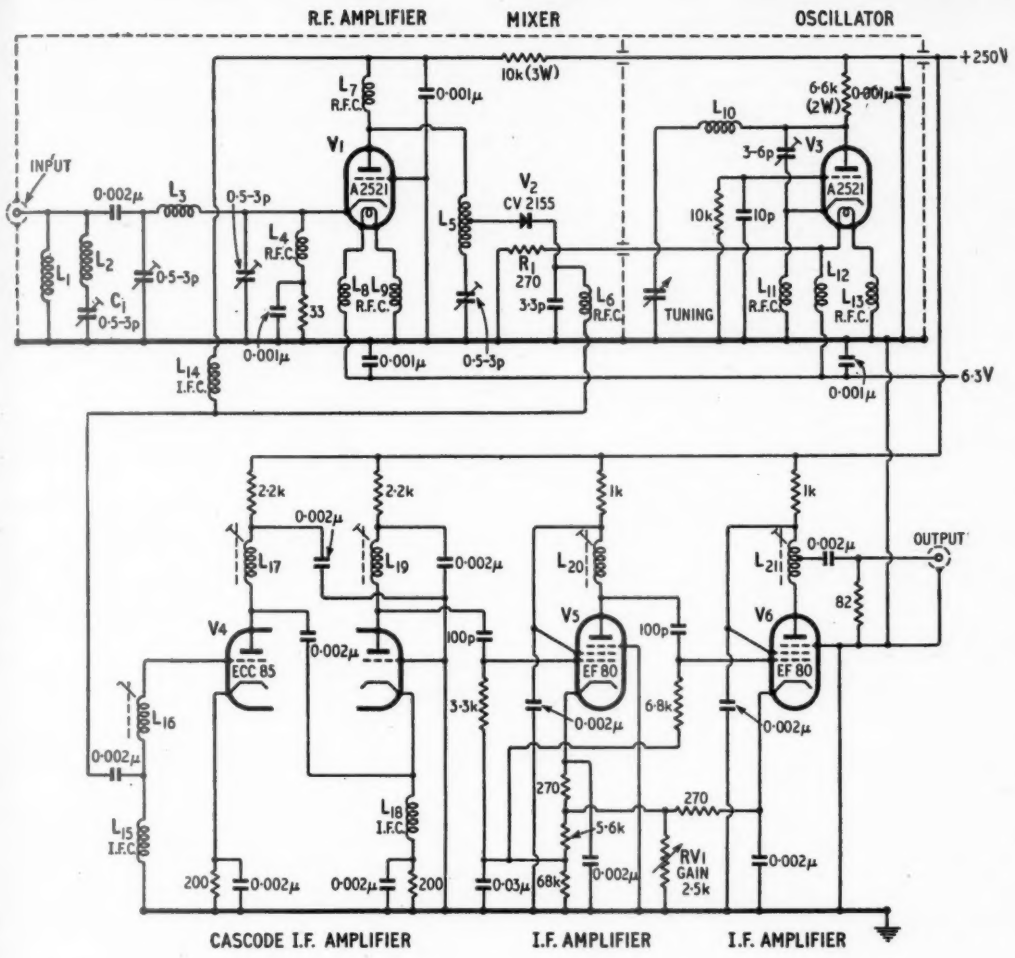
The addition of an r.f. amplifier stage will permit a worth-while improvement in the noise factor, but only a few valves really suitable for this application are available. The older disc-seal triodes achieve their performance by running with high anode currents, and it is necessary to use them in conjunction with large masses of metal to act as a heat sink for the anode seal. This form of construction is admirably suited to ultra low-loss co-axial circuits but would be prohibitively expensive for domestic use.

Recently introduced valves, however, will give satisfactory performances as u.h.f. amplifiers with only modest anode currents. One such is the M.O.V. Type A2521 which has an ordinary B9A base and the electrode assembly mounted horizontally and directly on the header pins. The claimed performance for

* E.M.I. Electronics Ltd.

R.F., mixer and oscillator section of the convertor; it comprises that part of the circuit enclosed by broken lines.





Theoretical circuit diagram of the Band V television convertor described in the text. The tuning capacitor is a modified air-space trimmer with plates removed to leave one fixed and one moving. All resistors ½-W unless otherwise stated.

this valve as an r.f. amplifier at 650 Mc/s is a power gain of 13.5dB with a 13-Mc/s bandwidth and a noise factor for the stage alone of 10dB.

A number of convertors have been manufactured and supplied for experimental Band-V reception by E.M.I. Electronics to the order of B.R.E.M.A. These use an A2521 valve as an r.f. amplifier, another as the local oscillator and a radar-type crystal diode, CV2155, as the mixer. This r.f. section is followed by a cascode double-triode first i.f. amplifier and two further pentode i.f. amplifiers as shown in the circuit diagram. The output is intended to be fed to a television monitor, or to a receiver having provision on the channel-selector switch for accepting a signal at the standard television i.f.

Since the valves are conventional plug-in types, it was decided to attempt to use ordinary television receiver-type components throughout. Series resonant circuits tuned with ceramic tubular preset capacitors have been found quite satisfactory, although the inductor reduces to a straight piece of 16 s.w.g. wire in some places. Small chokes of 0.1in diameter and self supporting, wound with a few turns of silk-covered wire are used where necessary and have been found to introduce negligible loss. In fact there are very few unconventional parts of the circuit. As can be seen in the illustration of the u.h.f. portion of the convertor, the oscillator anode inductor consists of two wires in parallel, the spacing between them being adjusted on test to bring the oscillator to the correct frequency with the variable capacitor at mid travel, thus obviating the necessity for a trimming capacitor, which would reduce the oscillation amplitude and restrict the frequency range available on the main tuning capacitor. Local oscillations for injection into the mixer circuit are taken from the live heater of the oscillator valve, and thence to earth through a 270-ohm resistor (R_1) placed close to the crystal. Adjustment of the relative position of V_2 and R_1

COIL WINDING DATA

L_1	1in of No. 18 s.w.g. tinned copper wire.
L_2	5 turns, 0.1in dia. No. 20 s.w.g. tinned copper wire, $\frac{3}{8}$in long.
L_3	$1\frac{1}{2}$in with 2 turns, 0.1in dia., spaced one wire diameter in the centre, No. 20 s.w.g. tinned copper wire.
L_4, L_5, L_6, L_7, L_8, L_9, L_{11}, L_{12}, L_{13}	R.F. choke, 10 turns closewound, 0.1in diameter. No. 22 s.w.g., d.s.c. air core.
L_{10}	Two, $1\frac{1}{2}$in long, No. 16 and No. 20 s.w.g. tinned copper wires in parallel.
L_{14}, L_{15}, L_{18}	I.F. chokes; 98 turns No. 44 s.w.g. En. on $\frac{5}{16}$in diameter moulded former.
L_{16}	$18\frac{1}{2}$ turns No. 28 s.w.g. En. closewound on $\frac{5}{16}$in dia. moulded former with dust core.
L_{17}, L_{19}	$14\frac{1}{2}$ turns otherwise as L_{16}.
L_{20}	$7\frac{1}{2}$ turns otherwise as L_{16}.
L_{21}	$21\frac{1}{2}$ turns tapped $3\frac{1}{2}$ turns from h.t. end otherwise as L_{16}.

permits the optimum crystal current to be achieved, while the resistance limits the heater current flowing. This arrangement has been found to give constant injection over the tuning range with negligible pulling or loading effects on the oscillator. The bandwidth of the r.f. circuits is set by adjustment of the crystal tap position on L_5. The rather large capacitance of the aerial input socket is roughly tuned out by an inductor (L_1), connected to the chassis and consisting of about one inch of wire; it gives the appearance of a short circuit on the input. A series resonant circuit (L_2C_1) at the image frequency (727Mc/s) is also added across the input circuit. This consists of a π network adjusted to give optimum aerial coupling for minimum noise factor. The coupling required differs considerably from that giving maximum power gain. Although not of primary importance in this application, it has been found that the oscillator drift over long periods of use is less than 500kc/s.

The performance specification achieved by this convertor is:—

Frequency	654.25Mc/s, tunable $\pm$5Mc/s
Gain	40dB.
Input and output impedance	75 ohms.
R.F. Bandwidth	$\pm$6.5Mc/s to $-$3dB points.
I.F. Bandwidth	33 to 40Mc/s, flat $\pm$1dB.
Noise Factor	10.5 to 11dB measured in 3Mc/s bandwidth.

Spurious responses at least 30dB down.

MAY MEETINGS

LONDON

6th. I.E.E.—"Some case histories of business computers in the U.S.A." by Dr. A. T. Starr at 5.30 at Savoy Place, W.C.2.

8th. Society of Instrument Technology.—"Control of the radio telescope" by Dr. J. G. Davies at 7.0 at Manson House, Portland Place, W.1.

9th. I.E.E.—Discussion on "The teaching of applied acoustics" opened by G. Mather at 6.0 at Savoy Place, W.C.2.

14th. I.E.E.—"A new cathode-ray tube for monochrome and colour television" by Dr. D. Gabor, P. R. Stuart and P. G. Kalman at 5.30 at Savoy Place, W.C.2.

15th. I.E.E.—Annual general meeting followed at 6.30 by "Recent developments in electronics in the United States" by D. G. Fink at Savoy Place, W.C.2.

16th. B.S.R.A.—Annual general meeting at 7.15 followed by "High fidelity in sound and colour" by Leslie Guest (Gaevart) at the Royal Society of Arts, John Adam Street, Adelphi, W.C.2.

19th. B.S.R.A.—Lecture-demonstration by RCA (Great Britain) at 7.0 at the Royal Society of Arts, John Adam Street, Adelphi, W.C.2.

19th-23rd. I.E.E.—International convention on microwave valves, Savoy Place, W.C.2.

21st. Brit.I.R.E.—"Cold cathode voltage transfer circuits" by J. H. Beesley at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1.

MALVERN

28th-29th. Physical Society.—Conference on spectroscopy of solids (including semiconductors, ionic conductors, metals and insulators) at the Royal Radar Establishment.

MANCHESTER

13th. Society of Instrument Technology.—Manchester section annual general meeting at 7.30 followed by "Magnetic amplifiers" by Dr. D. A. Bell at Manchester College of Technology.

LATE-APRIL MEETING

29th. Society of Relay Engineers.—"Television relay with particular reference to the BRW Mark II television relay equipment" by K. A. Russell (British Relay Wireless) at 2.30 at 21, Bloomsbury Street, London, W.C.1.

CLUB NEWS

Bournemouth.—A mobile rally is being organized by the Bournemouth Amateur Radio Society for Sunday, May 18th, in Kings Park, Boscombe. Two talk-in stations will be operating from 10.30 B.S.T. onwards (G2HIF/P on 145 Mc/s and G3HLW/P on 1880 kc/s). Sec.: C. R. Davies (G3JAU), 107, Talbot Road, Winton, Bournemouth.

Brighton.—The Brighton and District Radio Club meets each Tuesday at 8.0 at "The Eagle Inn," Gloucester Road. At the meeting on May 6th the Mullard film "Made for Life" will be shown. On May 20th J. P. Clement will deal with the cathrode-ray oscilloscope. Sec.: R. Purdy, 37, Bond Street, Brighton, 1.

Bury.—Aerials will be discussed at the technical forum of the Bury Radio Society on May 13th. Meetings are held at 8.0 at the George Hotel, Kay Gardens. Sec.: L. Robinson, 56, Avondale Avenue, Bury.

Gilwell Park.—Throughout the Scout weekend Jamboree at Gilwell Park on May 10th and 11th a radio transmitter is being operated by the Wanstead, Woodford and District Radio Club. It will use the call sign GB3BP. Two operating positions will be available, one for the 160 and 80 metre bands (to be confined to "G" calls), and the other for the 7 to 28 Mc/s bands. Transmissions will be mainly in the s.w. sections of these bands. Further details are obtainable from the organizing secretary, Boy Scout International Jamboree-on-the-Air, 965, Oxford Road, Tilehurst-on-Thames, Reading, Berks.

Prestatyn.—At the May 5th meeting of the Flintshire Radio Society the secretary of the club will speak about amateur television. The club meets at 7.30 at the Railway Hotel. Sec.: J. Thornton Lawrence (GW3JGA/T), 9, East Avenue, Bryn Newydd, Prestatyn.

Stockport-Manchester Rally.—A joint rally is being organized for May 18th by the Stockport Radio Society and South Manchester Radio Club. It is planned to include a mobile field-strength competition and a "walking" d.f. contest. Particulars are obtainable from C. M. Denny, 18, Willoughby Avenue, Didsbury, Manchester, 20.

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Our specialised MONITOR HEAD MODEL W.V.B. has an additional head and amplifier which enables this recorder to perform a number of useful functions. The most important of these is to monitor the recorded tape a fraction of a second after it is made, and if necessary compare it by throwing a switch, with the signal before it is recorded. This allows the recording engineer to make certain that he has made a first class recording before the artists leave the studio, without the necessity of waiting while another run though is made.

Additional items may be recorded one on top of another while listening to the first, since a switch is provided for the erase, and the bias, which also acts as a partial erase, can be lowered slightly, and its new value checked on the meter. In a similar manner the original signal may be fed back and recorded, resulting in an echo, the time constant of which is controlled by the speed of the tape and the distance apart of the heads.

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★ The meter fitted for reading signal level will also read bias voltage to enable a level response to be obtained under all circumstances. A control is provided for bias adjustment to compensate low mains or ageing valves.

★ A lower bias lifts the treble response and increases distortion. A high bias attenuates the treble and reduces distortion. The normal setting is inscribed for each instrument.

★ The distortion of the recording amplifier under recording conditions is too low to be accurately measured and is negligible.

★ A heavy mu-metal shielded microphone transformer is built in for 15-30 ohms balanced and screened line, and requires only 7 micro-volts approximately to fully load. This is equivalent to 20ft. from a ribbon microphone and the cable may be extended 440 yds. without appreciable loss.

★ The 0.5 megohm input is fully loaded by 18 millivolts and is suitable for crystal P.U.s, microphone or radio inputs.

★ A power plug is provided for a radio feeder unit, etc. Variable bass and treble controls are fitted for control of the play back signal.

★ The power output is 4 watts heavily damped by negative feedback and an oval internal speaker is built in for monitoring purposes.

★ The play back amplifier may be used as a microphone or gramophone amplifier separately or whilst recording is being made.

★ The unit may be left running on record or play back, even with 1,750ft. reels, with the lid closed.

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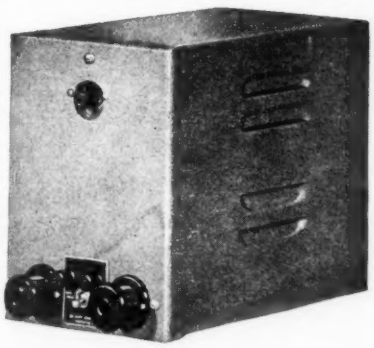

This D.C. to A.C. supply unit has been specially manufactured to provide 1% accurate 50 cycle A.C. power for 50 c/s synchronous motors and amplifiers sensitive to mains noise. The output from the 50 cycle is well filtered to reduce harmonics and give approximately the same degree of quietness as normal 50 cycle mains.

The efficiency is over 80% at wattages over 50. Terminals for a remote contro switch are fitted to prevent carrying the heavy low voltage L.T. cables any distance from the battery. The unit can then be fitted at the point closest to the battery to prevent voltage drop on leads and the A.C. satisfactorily extended to any required position.

The unit is fitted in an 18 gauge steel case to give screening, but it should not be placed close to tape heads in case the field causes slight hum.

The case measures 9in. x 6in. x 9in.

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88/9E	"Continental"	5¾" dia	850'	£1 . 10 . 6	£1 . 8 . 0
★99/12E	"	5¾" dia	1200'	£1 . 17 . 6	£1 . 15 . 0
88/12E	"Standard"	7" dia	1200'	£1 . 17 . 6	£1 . 15 . 0
★99/18E	"	7" dia	1800'	£2 . 12 . 6	£2 . 10 . 0

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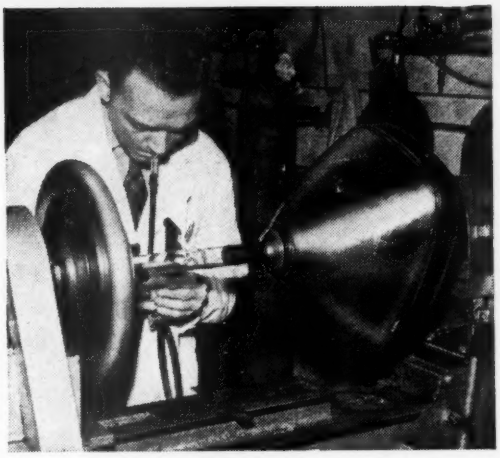
ES159

"NEW TUBES FOR OLD"

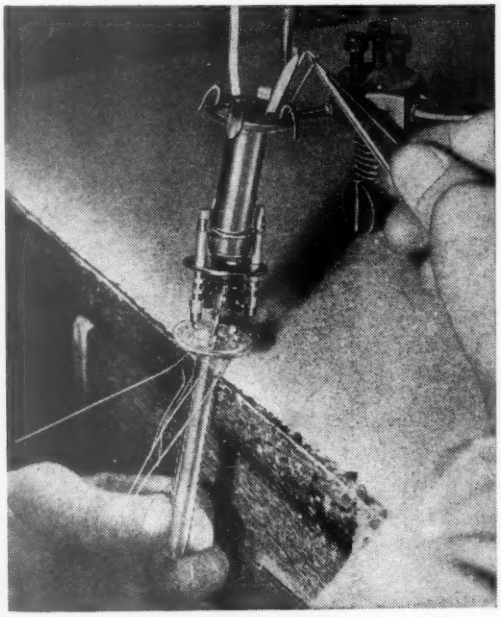
THE cry of the modern versions of Aladdin's magician uncle who offer to renovate worn-out cathode-ray tubes may be regarded with some suspicion by the more technically-minded television viewers. Terms like "reconditioning" and "renovating" in advertisements can mean various things, and even the more precise "re-gunning," "re-vacuuming" and "reactivating" leave some element of doubt on the exact nature of the techniques. There are, however, certain firms who are known for doing a very complete job of replacing the vital parts of the tube, as being the only sure means of obtaining a genuine new lease of life.

Recently *Wireless World* had the opportunity of seeing this kind of process being performed at the works of Nu-Life Teletubes at Greenford, Middlesex. Here the vital parts replaced are the cathode and the heater. This can be loosely described as "re-gunning," although in fact the remainder of the electron-gun assembly is used again in its original form.

After a general cleaning-up of the tube, the first step is to test the screen with ultra-violet radiation (applied externally) to see if it is still sufficiently active and free from ion burns and other flaws. When a screen is found to be faulty the radio dealer or owner who sent in the tube is advised that re-gunning will not be worth while. The next process, after removal of the base, is to let air into the tube. This has to be done very slowly and carefully, as a too sudden rush of air would tear off the fluorescent screen. A tiny crack is made in the tube neck near the base by means of an electrically heated wire, and this allows the air to seep in gradually over a period of several hours.



Jointing a new section of glass tubing on to the existing neck.



Reassembled electron gun mounted on a new glass pinch with evacuating tube.

When the inside and outside pressures have been equalized the glass pinch is parted from the tube neck and the electrode assembly mounted on it is withdrawn. The glass pinch itself is removed from the electrode support wires and the cathode and heater assembly is taken out of the electron gun. The coiled tungsten heater wire and capped nickel cathode tube are prepared and coated with the appropriate oxides—providing insulation for the heater and emissive material for the cathode.

Grid-Cathode Spacing

Replacing the cathode-heater assembly in the electron gun is a highly critical business, because the cathode surface has to be very close to the grid aperture (about 12-15 thou') and the spacing must be adjusted to be exactly as in the original gun to preserve the electron-optical design and tube characteristics. An optical system of adjustment is used in which a beam of light shines obliquely through the grid aperture on to the cathode surface, and the grid-cathode spacing is altered until the shadow of the grid-aperture edge falls in a predetermined position. The light-beam angle of incidence is calibrated directly in terms of grid-cathode spacing.

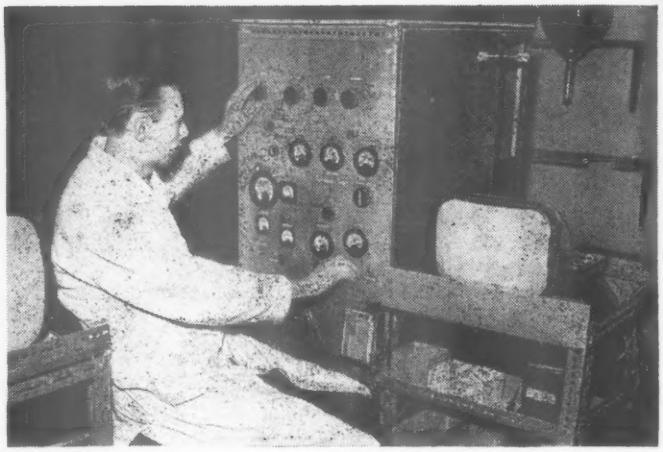
After a new getter has been welded to the electrode assembly and the whole structure has been mounted on a new pinch fitted with an evacuation tube, the electron gun is ready to be put back in the c.r.t. Meanwhile, a new length of glass neck has been joined to the existing neck of the tube on a glass-blowers' lathe. The reconditioned gun is inserted into this new section of neck and aligned

axially by means of a jig, after which the neck glass is melted by a blow-pipe at the right place to join on to the pinch.

Vacuum pumping is the next operation, and this is done on an equipment consisting of a rotary pump backing an oil diffusion pump. The process takes a considerable time—several hours, depending on the size of the tube—because the tube has to be baked in an oven during evacuation to liberate adsorbed gases in the glass and metal, and there is a safe limit to the speed at which it can be heated up and cooled down while under pressure. At the end of the pumping process the getter is fired by h.f. induction heating to complete the vacuum and the tube is sealed off from the pump. Finally the base is refitted and the envelope is recoated with graphite (the original coat having been removed during the initial cleaning).

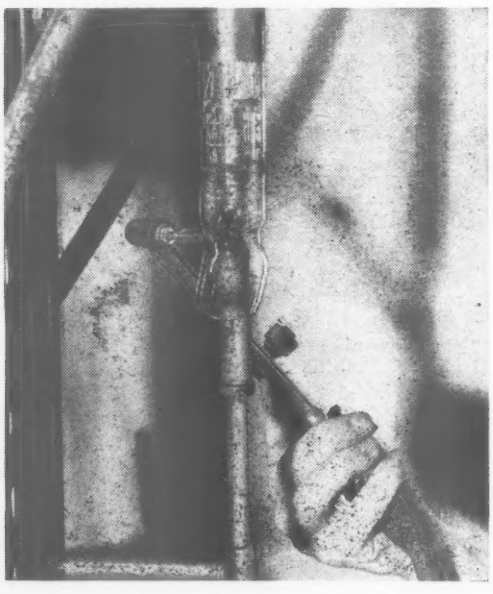
The reconditioned tube is put through a series of tests similar to those applied in c.r.t. manufacture, and is sent back to the dealer or private owner with a guarantee of six months. A client can always be sure of getting back the same tube that he sent in.

One point which particularly impressed *Wireless World* was the high degree of individual skill and craftsmanship required in this sort of work. The reconditioned tubes are virtually hand-made jobs, comparable with those produced in the early days of television. There seems no reason why they should not be as good as the originals. The fact that the service is used by several well-known radio manufacturers, including at least one producer of cathode-ray tubes, is fair enough comment in itself!



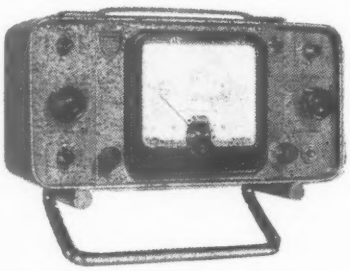
Test equipment for the completed tubes.

Melting the new neck on to the pinch. When the glass is softened the weight of the surplus piece pulls in the neck to join with the pinch. A jig holds the electron gun in the correct position.



Transistor D.C. Voltmeter

FOUR basic ranges with full-scale deflections of 1 to 1,000V, each with an internal resistance of 150,000 ohms per volt, are provided in the Amos of Exeter model



Amos of Exeter transistor d.c. voltmeter.

140 d.c. voltmeter. A "divide-by-two" button for each range halves the full-scale deflection and doubles the internal resistance per volt. Three additional ranges with full-scale deflections of 5, 10 and 20kV can be obtained by the use of a high-voltage probe housing a 200MΩ resistor. The accuracy is said to be better than 2% of the f.s.d. on all ranges. Two grounded-emitter-connected transistors in a balanced linear d.c. amplifier circuit are used. These are mounted in a 1×½in solid metal heat sink packed with glass wool inside a case which reflects heat from outside. Under normal bench conditions a reading will not vary more than 1% every two hours due to temperature changes. A 7½V reference supply accurate to 1% is built in, and the total standing drain from the 4½V transistor supply is 300μA. The range of the set zero control is wide enough to give centre-zero scale facilities if desired. Protection against overload is also provided. This voltmeter costs £34, and is distributed by Soundrite, Ltd., 82-83, New Bond Street, London, W.1.

EXHIBITIONS AND CONFERENCES

FURTHER details of the exhibitions and conferences listed below are obtainable from the addresses given in brackets. British manufacturers can obtain information regarding exhibiting at the shows from the Board of Trade, Export Publicity and Fairs Branch, Lacon House, Theobalds Road, London, W.C.1.

UNITED KINGDOM

International Convention on Microwave Valves, Savoy Place, London, W.C.2. ..... May 19-23
(I.E.E., Savoy Place, London, W.C.2)

European Television Exhibition, Park Lane House, London, W.1. ... May 19-24
(Prestige Promotions, Ltd., 45 Park Lane, London, W.1.)

Electronics Exhibition and Convention, Manchester College of Science and Technology ..... July 10-16
(Institution of Electronics, 78 Shaw Road, Rochdale, Lancs.)

National Radio Show, Earls Court, London, S.W.5 ..... Aug. 27-Sept. 6
(Radio Industry Council, 56 Russell Sq., London, W.C.1.)

Farnborough Air Show ..... Sept. 1-7
(Society of British Aircraft Constructors, 29 King St., London, S.W.1.)

Convention of Scientific Instrument Manufacturers, Majestic Hotel, Harrogate ..... Nov. 6-9
(S.I.M.A., 20 Queen Anne St., London, W.1.)

Electronic Computer Exhibition, Olympia, London, W.14 ..... Nov. 28-Dec. 4
(Electronic Engineering Association, 11 Green St., London, W.1.)

OVERSEAS

British Electrical Conference, Brussels, Belgium ..... May 16-17
(Secretariat, 36 Kingsway, London, W.C.2.)

International Conference on Solid State Physics in Electronics and Telecommunications, Brussels, Belgium ..... June 2-7
(Société Belge de Physique, 18 rue de Phillipeville, Loveral, Belgium.)

Armed Forces Communications and Electronics Association Convention and Exhibition, Washington, D.C., U.S.A. ..... June 4-6
(A.F.C.E.A., 1624 Eye St., N.W., Washington 6, D.C., U.S.A.)

International Automation Exposition and Congress, New York, U.S.A. .. June 9-13
(Rimbach Associates, 845 Ridge Ave., Pittsburgh 12, U.S.A.)

International Congress and Exhibition of Electronics and Atomic Energy, Rome, Italy ..... June 16-30
(London Agents: Auger and Turner, 40, Gerrard St., London, W.1.)

French Components Show, Paris, France ..... June 20-26
(S.N.I.R., 23 rue de Lubeck, Paris 16.)

International Conference on Semi-conductors, Rochester, N.Y., U.S.A. Aug. 18-23
(G.E.C. Research Lab., P.O. Box 1088, Schenectady, N.Y., U.S.A.)

Western Electronic Show and Convention, Los Angeles, U.S.A. ..... Aug. 19-22
(Wescon, 1435 South La Cienega Boulevard, Los Angeles 35, Cal., U.S.A.)

Colloquim on Electronic Properties of Metals at Low Temperatures, Geneva, N.Y., U.S.A. ..... Aug. 25-29
(International Union of Pure and Applied Physics, 3 Boulevard Pasteur, Paris 15, France.)

Swiss Radio, Television and Recording Show, Zurich, Switzerland Aug. 28-Sept. 2
(W. Von Liliencron, 15 Strassburg Strasse, Zurich.)

International Analogy Computation Meeting, Strasbourg, France ..... Sept. 1-9
(F. H. Raymond, 138 Boulevard de Verdun, Courbevoie (Seine).)

International Congress on Cybernetics, Namur, Belgium ..... Sept. 3-10
(International Assoc. for Cybernetics, 13 rue Basse-Marcelle, Namur.)

Instrument-Automation Conference and Show, Philadelphia, U.S.A. Sept. 15-19
(Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.)

International Symposium on Nuclear Electronics, Paris, France ..... Sept. 16-20
(Société des Radioélectriciens, 10 av. Pierre-Larousse, Malakoff (Seine).)

International Radio-Television-Electronics Fair, Amsterdam, Netherlands. Sept. 22-29
(H. J. Kazemier, Emmalaan 20, Amsterdam Z.)

Irish Radio and Television Show, Mansion House, Dublin, Eire ..... Sept. 23-27
(*Irish Radio & Electrical Journal*, 14-15 Dame Street, Dublin, Eire.)

National Electronics Conference, Chicago, U.S.A. ..... Oct. 13-15
(N.E.C., 84 East Randolph St., Chicago, Ill., U.S.A.)

International Radio and Telecommunications Fair, Ljubljana, Yugoslavia Oct. 31-Nov. 9
(Gospodarsko Razstavisce, Titova 48, Ljubljana.)

International Conference on Scientific Information, Washington, D.C., U.S.A. Nov. 16-23
(Secretariat, 2101 Constitution Ave., Washington, D.C., U.S.A.)

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RANDOM RADIATIONS

By "DIALLIST"

Is TV Sound "Hi-Fi" ?

"SEEING the heading of your note on 'hi-fi' TV," writes a Hampton Hill reader, "I hoped you were going to deal with the sound." Heaps of people, he says, have the mistaken idea that their television sound *is* "hi-fi," presumably because their dealers have told them so. It isn't, of course, though reproduction can be made a good deal more pleasing to the ear than that of medium-wave programmes. You can hardly expect "hi-fi" with single pentode output and a small (usually elliptical) loudspeaker crammed into the cabinet of a table model. And since probably well over six million of the eight million TV sets now in use are table models, it would hardly be worth while to transmit high-quality sound. Nor, I believe, would most people be able to appreciate it. They're so occupied by what's on the screen that the sound has to be very bad indeed before they notice that anything is amiss with it. One possible exception is the sound accompanying TV transmissions of concerts. Really musical people, I know, like to watch them in order to study the techniques of the conductor and of the instrumental soloists. But I'd far rather hear a concert on my v.h.f. receiver. And anyhow there are songsters of both sexes who are much better heard and not seen! If you have a console TV set, there's generally room in the lower compartment for a good-sized loudspeaker, and by improving the audio circuit you can obtain sound which is very pleasant to listen to.

The Synchroguide

IN a recent issue I mentioned that I'd been unable to send to a South African reader the particulars of the Synchroguide system of line-scan sync because I hadn't the full circuit with component values. Now a Canadian reader, whose present home is in the U.S.A., has sent me full details of the RCA Synchroguide. If my South African reader cares to write again (I've mislaid his address), I'll be happy to send them on to him and they should tell him all he wants to know. He, if you remember, receives the London TV transmissions, the only snag being that the sync signals haven't sufficient amplitude to lock his line scan. Accounts of reception of the Crystal Palace come from all sorts of distant places.* It was reported in the dailies not long ago that a Moscow amateur has built himself a set which regularly pulled in London. I suppose that most, if not all, of this extraordinary DX reception is due to the present spottiness of the sun and that we'll hear less and less of it as old Sol's complexion clears on the approach of a sunspot minimum.

* See letter in this issue from an Australian reader.—ED.

Interference Problems

THERE are so many possible sources of interference with broadcast transmissions on the medium and long wavelengths and with television on Bands I and III that one is sometimes tempted to wonder that anyone ever satisfactorily receives a sound or vision programme. But, thank goodness, a very respectable proportion of listeners and viewers manage to do so Most people, I suppose, can come to tolerate a certain amount of interference and not a few whose homes are close to roads carrying heavy motor traffic must be able to accept it as just one of those things. If that weren't so one wouldn't see such numbers of TV aerials above houses so placed. Continuous and violent interference, though, is something that no one can put up with, especially if he's receiving a TV signal in a fringe-area. Some of this arises from high-voltage power-lines under certain weather conditions. But there are too many preventable kinds of interference knocking about. One of them—and a pretty common one, as P.O. engineers know to their cost —is due to the conversion of TV sets of unsuitable types for Band III reception, or the use of convertors of the wrong kind.

I.T.A. Sound on F.M. Receivers

SEVERAL readers report that on their f.m. receivers they can pick up the I.T.A.'s sound or vision signals by putting their sets slightly off tune. All of those who have had such experiences appear to live within quite short distances from both I.T.A. television and B.B.C. f.m. transmitters. All tell me that they receive the I.T.A. signals at settings corresponding to frequencies bearing no apparent relation to those on which they are sent out. It seems not unlikely, then, that the very strong I.T.A. signals are beating with some harmonic of the local oscillator frequency and so forcing their way in. I'd welcome further information on the subject from any who'll be kind enough to send it along.

F.M. in France

THOUGH the expansion of her television system has been to a large extent held up by the economy squeeze, France is going right ahead with the development of a country-wide v.h.f./f.m. network. It is hoped that all the stations will be in action before the end of this year. The biggest snag, it is feared, may be the inability of the P.T.T. land-lines to cope with anything like the 15 kc/s frequency band which the transmitters are designed to handle. Radio links can be difficult in such mountainous country as is found in many parts of France and their installation would in any case considerably increase the cost of the scheme. It may be that to begin with the quality is not as good as it might be. But the French are such good engineers that I've little doubt that f.m. in that country will before long be as good as any in the world.

What is a Billion ?

A LETTER from Reading refers to my March paragraph on the difference between the British billion (10^{12}) and the American billion (10^{9}). The writer says "We are informed by our atomic physics folk that they use 10^{9}, symbol G." Will I please comment? he asks. I don't think that there's any doubt that the commonly accepted value of the British billion is, at any rate in non-scientific circles, 10^{12}. That is what my dictionary shows and it goes on to give trillion as 10^{18}, quadrillion as 10^{24} and so on. But France, the United States and many other countries use 10^{9} for billion, and it's quite likely that some, though not all I think, of our scientific people

have come into line, with the idea of preventing misunderstandings. Actually, if some people have changed to 10^9 and others stick to 10^{12} for the billion, misunderstandings are bound to be increased, as I pointed out. Wouldn't it be a whole lot better if everyone agreed to drop all those numerals above million ending in "illion" and to use the index system instead? Nowadays most people who use large numbers in their calculations are familiar with what one of H. G. Wells's characters referred to as "the little two hup hin the hair."

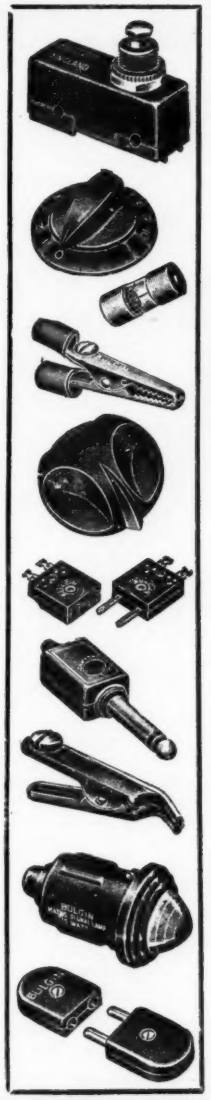
Factor of Safety

FAR too many breakdowns occur nowadays in resistors, capacitors and other bits and pieces used in sound and television sets. One can't help feeling that components with an insufficient factor of safety are too often used in order to keep costs down. The market is, of course, a highly competitive one and if the non-technical buyer sees two 17-inch TV sets, both equally attractive to the eye and both showing a similar picture, he'll be apt to go for the cheaper one. He may be lucky and have little or no subsequent trouble; but if some of the components in his new set are barely up to their job of work, he may have to spend on repair work far more than he "saved" on the purchase price.

The Things They Write

EVEN in these days, when the majority of our folk are users in one way or another of electricity, people do write and say some rather astonishing things about it. Here's one example, culled from a national daily newspaper:

"TAPED.—Seven years after the electricity meter was removed a house was found reconnected to the main cable with insulating tape. . . ." Hardly, one imagines, the best of conductors! And here's another from a hearing-aid advertisement. "Magnetic waves (*help!*) are those we hear from telephones, radios, televisions (*sic*), etc. With this aid you can listen to normal conversation, then by switching to 'magnetic' you can hear magnetic waves perfectly, without distortion" (my italics). And in a crossword I came across the clue: "Official letters can be electrifying (4)." The answer was, of course "ohms"; but it's more than a mite difficult to see how the unit of resistance could be the active promoter of any kind of electrification.



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I AM delighted to see that a prominent manufacturer has followed the example of introducing automation in the office, which I set in pre-war days, when I introduced closed-circuit TV to assist a prominent executive to engage a new secretary without yielding to the human weakness of letting his better judgment be over-ruled by purely physical considerations. For those of you who have forgotten it, I reproduce my original sketch from *W.W.* for June 22nd, 1939, showing him rejecting a candidate—albeit reluctantly—for reasons which will be obvious to you.

There are other disturbing factors apart from female pulchritude which upset office routine. One of these is the tea break, sanctity of which seems to have become inviolable. It is this inviolability which a prominent manufacturer has had the courage to tackle by introducing automation in the shape of an ingenious electronically operated tea-break timer.

A reluctant rejection.

This consists of a neat unit which indicates the beginning of the chatasting interval by the clanging of an electric bell. Ten minutes later the bell sounds again automatically to signal its close. One of the most interesting features of it is that the normal interval of 10 minutes can be extended to 15, 30, 45, or even 60 minutes, thus making the instrument suitable for use in Government offices.

While admiring the practical knowledge of modern office routine which the designer of this interesting device shows, the use of a commonplace electric bell to signal the start of such a sacred ritual as chalatry seems to show a certain lack of imagination. Having regard to the quality of office tea it would surely be better to have a short recorded excerpt from Handel's "Water Music" to start the ceremony, the closure being indicated by one of the more sombre settings to the *Miserere*.

Stereo in Paediatrics

IN HIS letter in the April issue, Mr. Antonios Simonis—obviously a scion of the land of Socrates and Plato—appears to rebuke me for saying that our modern witch-word "stereo" is derived from the Greek verb of that name. In actual fact he goes to some trouble to prove that what I said was correct, for I made it quite clear—as he does also—that our word "stereo" was not derived from the Greek verb meaning "to deprive of."

The only point on which we differed is a trifling one. I spoke of the verb as "stereo" whereas in his letter he uses the Attic contracted form of "stero" in which the penultimate "e" disappears in favour of a circumflex accent over the omega. This is also its modern Greek form except that they have streamlined the circumflex accent.

Now although we both agree in stating somewhat dogmatically that the Greek verb has no place in the ancestry of our 3-D word "stereo," I have a nasty feeling that we may both be wrong. It certainly seems strange that too such very similar words as "stereo" and "stereos" (or stereo and sterion as Mr. Simonis says) should have no relationship to each other.

But their English meanings of "to deprive of" and "solid" seem to be poles asunder until we remember that, at a certain period of its life, an infant is "deprived of" its natural nourishment and put on to "solid" food. Surely, in this simple fact of paediatrics, there is a very natural link between the words? I have taken some pains to work that one out and I hope none of you classical "scolards" is going to hold me up to public ridicule.

I find a certain amount of support for my view in the works of the Rev. John Parkhurst, fellow of Clare-Hall, Cambridge, a noted Greek and Hebrew scholar of Hanoverian times who earned some claim to fame by being—as he himself makes clear—the first man to make Greek available to the masses by publishing a grammar which was not based on the supposition that they were already well-acquainted with Latin. I have always thought that the good man overlooked the fact that they might also be not well acquainted with reading and writing English in the year 1769 when he first issued this work.

Bureaucratic Bumbledom

WE ALL receive an annual reminder to renew our wireless, driving and other licences. I suppose few people read these reminders and I must confess I have never done so until this year. This accounts for the fact that I have never before noticed on the wireless-licence reminder the impertinent request which says: "If you are not renewing your licence please state the reason below."

I cannot think of any other activity requiring a licence where a reason is demanded for non-renewal. If I don't renew my driving licence I don't have to give any reason for not doing so. I am spared the humiliation of saying that I can no longer afford to run a car because my expectations under my mother-in-law's will have not been realized.

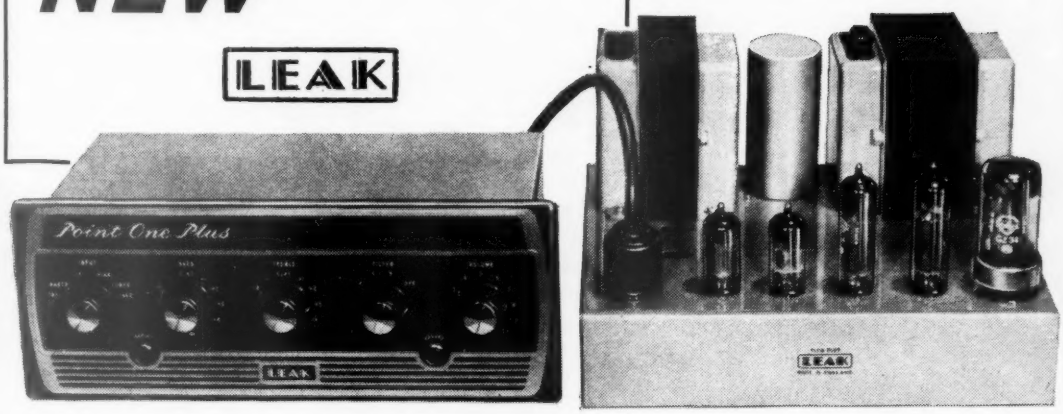
I wonder if any of you know if any legal penalties are incurred for failing to give a reason. If I don't wish to renew my licence, I don't know what reason would be acceptable to the P.M.G.; in fact, I don't know why on earth he wants any reason at all.

A wireless receiving licence is, after all, a permit to establish and operate a wireless receiving station and the money given for it is in no sense payment for value received in the form of entertainment. It could, therefore, obviously be of no use my telling the P.M.G. that I was dissatisfied with the programmes as he could rightly retort that a licence would still be necessary even if all programmes ceased. The correct answer would, I suppose, be "I am not renewing my licence because I am no longer operating a wireless receiving station." But that would only lead to the P.M.G. asking a supplementary question: "Why are you no longer intending to operate a wireless receiving station?"

If the P.M.G. must ask this impertinent question surely he could print half a dozen answers and tell us to strike out those not applicable. However, I doubt whether the Wireless Telegraphy Act or any other Act of Parliament gives any authority to the P.M.G. for this piece of bureaucratic bumbledom.

NEW

LEAK



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LEAK amplifiers have been the choice of the B.B.C. (over 500 delivered), the South African Broadcasting Corporation (600), I.T.V. and many other Commonwealth and overseas broadcasting and TV systems, who use them for transmitting and/or monitoring (quality checking) the broadcasts to which you listen. Also, many of the gramophone records you buy are cut via LEAK amplifiers. This acceptance by professional audio engineers has led to a demand for LEAK equipment from music-lovers throughout the world.

It is appropriate here to mention one of the basic principles of LEAK design. From long experience and by extreme attention to design details during development work on the pre-production models, we enable our craftsmen to achieve a high output per man-hour. The labour costs thus saved offset the increased costs incurred for high-grade materials, components and finishes, and this together with quantity production (made possible only by a world-wide market) explains how quality products may be sold at reasonable prices.

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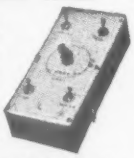
Tube Tester and Re-Activator

We can supply all the main components for making this unit which will not only test Cathode Ray Tubes but also will re-activate them, supplied complete with full instructions. Price **£3**, plus 2/6 post and ins.

Transistor Timer



All the parts for making transistorised Enlarging or Process Timer with constructional details. **£2/10/-**, plus 2/6 post and pkg.

Beginner's Superhet

All the components including metal chassis, valves, metal rectifier, coils, tuning condenser, etc., etc. required to build the "Beginner's Superhet" as described in the January issue, are available as a parcel. Price **£3**, plus 3/- post and ins.

Condenser Tester and Re-Activator

This unit tests condensers under correct working conditions at proper voltages, it can also be used for "reforming" electrolytics. All basic parts and full instructions, **50/-**, plus 2/6 post and ins.

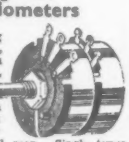
Band III Converter

Suitable Wales, London, Midlands, North, Scotland etc. All the parts including 2 EF80 valves, coils, fine tuner, contrast control, condensers, and resistors. (Metal case available as an extra.) Price only **19/6**, plus 2/6 post and insurance. Data free with parts or available separately **1/6**.

Making a Solder Gun

A 7-second solder gun of this type costing £3-£4 was described in Prac. Mech. Only two essential parts are required—(a) transformer and (b) push switch. These we can supply at **13/6**, plus 2/- post. The rest of the parts you will have in your own "junk" box. Copy of the article concerned given free with the kit.

Morganite Potentiometers



Single and 2 gang types available, standard size with good length spindle, and new and boxed gang type 3/- each —values available: 5K + 5K, 100K + 100K, ½ meg. + ½ meg. Single types 1/- each. Values available: 10K, 25K, 50K, 100K, 250K, 1 meg., 2 meg.

Connecting Wire

P.V.C. covered in 100ft. coils—**2/9** a coil or four coils different colours, **10/-**, post free.

Mains Transformer. 250-0-250, 60-80 mA. 6.3 v. standard mains input. Half shrouded, **15/-**, post and insurance 2/6.

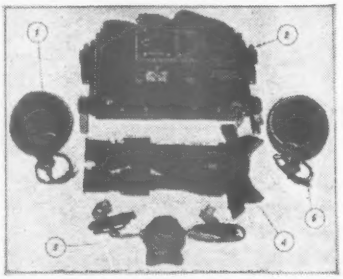
.1 mfd. 350 v. Small Tubular Metal Cased Condensers. Made by Dubilier. **2/6** per dozen.

Germanium Diodes. B.T.H., with wire ends. **10d.** each or **9/-** dozen.

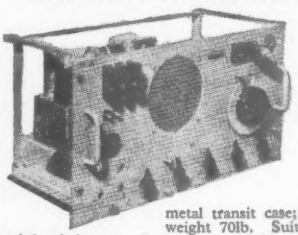
Midget I.F. Coils. Dust cored, size 1½ × 1in., 465 Kc/s. **6/6** pair.

COMPLETE SEE-IN-THE-DARK EQUIPMENT

Complete equipment as fitted to Army vehicles for night driving, etc. Comprises: 2 Infra Red Radiators, adjustable binoculars, powerpack for 6 or 12 volts, control units and inter-connection cables. Original cost probably around £100. Unused and in perfect order—**£10**, plus 10/- carriage and insurance.



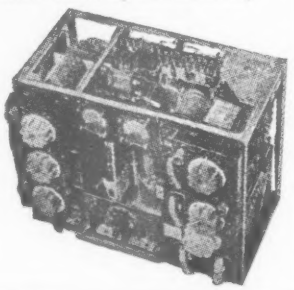
Short Wave Communications Receiver R208



This is a super short wave receiver covering 5-30 metres (10-60 mc/s) Uses 6 valves. Has R.F. stage, 2 I.F. stages B.F.O. etc. Muirhead instrument drive, two internal power packs, mains and battery vibrator pack. Complete with own P.M. speaker. Provision for phones and speaker muting. Complete in metal transit case; size approx. 24 × 18 × 12; weight 70lb. Suitable A.C. mains, 100-250 and 6 volt battery. In perfect condition, practically unused. Tested before despatch and guaranteed. Handbook free with each. Price £6/19/6, carriage and insurance 15/-.

Famous Transmitter Virtually Given Away

The famous R1154 —unused but slightly soiled and not tested. Covers 200-500 Kc/s., 3-5.5 mc/s and 5.5-10 mc/s. Has unique "click stop" mechanism (7 stops) and permits selected frequency to be held, returned to, etc. Hartley oscillator, power amplifier, keying and speech. Wonderful breakdown value meters, relays, switches. Complete with valves—real bargain at **29/6**, plus 10/- carriage.



A.C./D.C. Multimeter Kit

Ranges: D.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000. A.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000.

D.C. milliamps 0-5, 0-100, 0-500. Ohms 0-50,000 with internal batteries. 0-500,000 with external batteries.

Measures A.C./D.C. volts, D.C. current and ohms. All the essential parts including metal case, 2in. moving coil meter, selected resistors, wire for shunts, range selector, switches, calibrated scale and full instructions, price **19/6**, plus 2/6 post and insurance.

Telephone Repeater No. 1, Mark I

This equipment is for amplifying telephone signals in both directions of traffic and also to remedy line distortion of speech. It is intended for use with two wire or four wire circuits, has four amplifiers and is in fact two quite independent repeaters mounted on the same panel and having a common power supply. The power supply may be operated from 12-volt car battery or from standard A.C. mains. The units are absolutely new in original packing complete with spares and instructional manual. Price £20 each.

Hi-Fi Bargain

12in. Hi-fidelity loudspeaker. High flux, permanent magnet type with standard 3 ohm speech coil. Will handle up to 12 watts. Brand new by famous maker. Price **32/6**, plus 2/6 post and insurance.

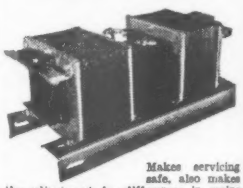
Yaxley Switches

3-pole, 2-way	1/3
12-pole, 2-way	1/6
3-pole, 3-way	1/6
9-pole, 3-way	2/-
2-pole, 4-way	2/-
6-pole, 4-way	2/6
4-pole, 5-way	2/6
2-pole, 6-way	2/6
1-pole, 7-way	2/6
1-pole, 12-way	2/6
6-position shorting switch	2/-
Double-pole mains switch for attaching to Yaxley switches	1/6

Discount of 10% allowed where a dozen of one type ordered.

Special quotes 144 or over.

MAINS ISOLATION TRANSFORMER



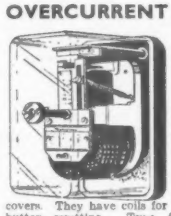
Makes servicing safe, also makes the adjustment for differences in mains voltages very simple Input tapped 200-250 v., output tapped 200-250 v. Continuously rated at 500 watts, intermittent rating 2,000 watts. Cable entry by terminal blocks, two separate screens for suppressing mains interference. Size approximately 14in. × 6in. × 6in., weight approximately 40lb. Price **£5/12/6**. Carriage and insurance 7/6 (up to 250 miles).

W.D. CIRCUIT DETAILS

Diagrams and other information extracted from official manuals. All **1/6** per copy, 12 for **15/-**.

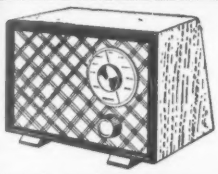
American Service Sheets	R.109
A.1134	78 receiver
BC.348	76 receiver
BC.312	B28/ARC5
R.103A	B1116/A
R.107	RA-1B
B.C.342	AR88D
BA-1B	AN/APA-1
R-208	78
R-1155	76
R-1124A	B.T.18
R-1132A/R-1481	CAY-46-AAM-RADAR
R-1147	A.S.B.-3
R-1224A	Indicator 62A
R-1082	Indicator A.S.B.3
R-1355	Indicator 62
B.C.1206-A/B	Indicator 6K
B-455-A (or -B)	R.F. unit 24
B-454-A (or -B)	R.F. unit 26
B-453-A (or -B)	R.F. unit 25
Transmitter T1154/ B.D.J.N.	R.F. unit 27
58 walkie-talkie	Wireless set No. 19
Frequency meter B.C.221	Demobbed valves

OVERCURRENT RELAY



Beautifully made by the famous American Weating-house Company. These are the surface mounting through panel type with clear Pyrex glass covers. They have coils for remote push button resetting. Type A—calibrated for currents between .1 and .4 amps. Type B—calibrated for currents between .5 and 2 amps. Price, unused and perfect, **£3/17/6** each.

XUM



THE SKYSEARCHER

This is a 2-valve plus-metal receiver set useful as an educational set for beginners, also makes a fine second set for the bedroom, workshop, etc. All parts, less cabinet, chassis and speaker, **19/6**. Post and ins. 2/6. Data free with parts or available separately **1/6**. 3-valve battery version also available at the same price.

ALL-MAINS AMPLIFIER

Powerful three-valve. Mains amplifier ideal for dances, parties, etc. Complete less chassis, cabinet and speaker (available if required)—data 1/6 (free with parts). Price **19/6**, plus 2/6 post and insurance.

CLOCK CASE

Also suitable for barometer or other instrument. Nicely polished. Price **4/6**, post and packing 1/6.

Clock numerals to suit these cases etched on metal, **2/6**.

Post 9d. if ordered separately.

Simplex Transistor Kit

Makes ideal bedroom radio, uses one transistor and one crystal diode. Complete less case **19/6**, case 5/- extra, post and ins. 1/6.

GLASS PANELS

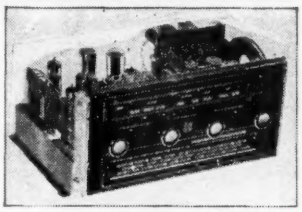
Size 10½ × 9½—parcel of five panels.

8/6

Post free

MINI-RADIO

Uses high-efficiency coils—covers long and medium wavebands and fits into the neat white or brown Bakelite cabinet—limited quantity only. All the parts, including cabinet, valves, in fact, everything, **£4/10/-**, plus 3/6 post. Constructional data free with the parts, or available separately, **1/6**.



AM/FM Chassis

Made by the famous McCarthy Radio. This employs a printed circuit in the F.M. Tuner section, it uses 8 valves and has a very attractive three colour dial, size approximately 12 × 5½in., covers four wavebands: 1,000-2,000 m., 200-550 m., 15-50 m., and 88-100 mc/s. This is a precision made chassis with four controls, tuner, volume, wavechange and tone. Fully guar. Price **£22/10/-**, post and ins. 5/-.

"THE CRISPIAN" BATTERY PORTABLE

A 4-valve truly portable battery set with very many good features as follows:—

- **Ferrite Rod Aerial.**
- **Low consumption valves (DK96 range).**
- **Superhet circuit with A.V.C.**
- **Ready built and aligned chassis if required.**
- **Beautiful two-tone cabinet.**
- **Guaranteed results on long and medium waves anywhere.**

All parts, including speaker and cabinet, are available separately, or if all ordered together the price is **£7/15/-** complete. **£1/15/-** deposit and seven monthly payments of **£1**. Post and insurance 3/6. Ready built chassis **30/-** extra. Instruction booklet free with parts or available separately **1/6**.

A FREE GIFT WITH YOUR AVO

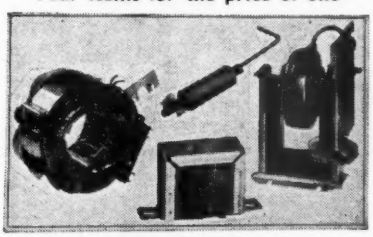
Like all AVO meters it is a very fine instrument; it has a sensitivity of 10,000 ohms per volt and 19 most useful ranges as follows:—D.C. volts 0-1,000 (seven ranges). A.C. volts 0-1,000 (five ranges). D.C. Current 0-1 amp. (5 ranges), resistance 0-2 megs. (2 ranges) (complete with test leads) Immediate delivery. **Cash price £9/10/—non-callers please add 3/6 post and ins.**

FREE GIFT.—All purchasers of the above item this month will receive the M.M. Range Extender which adds capacity 0.1 m.f. in two ranges —inductance 0-100 henrys and decible —20 to +36.

THIS MONTH'S SNIP

A 5.K.V.A. Oil Cooled Power Transformer for 440/480V. 3 phases to 230/250V. single phase 50 cycles. Limited quantity **£25** each ex works.

Four items for the price of one



This set of modern T.V. parts is equally suitable for modernising an old televisoror for building into a new one. Suitable for wide angle 14in or 17in. tubes using E.H.T. or 12-14 K.V. The four items comprise: (1) line output E.H.T. transformer; (2) 70° scanning coils on ferrite yokes; (3) width control with ferrite core; (4) frame output transformer. With these parts we also give free, complete circuit diagram of modern televisor which uses them. We offer the whole lot at the price of the line output transformer only, namely **57/6**, plus 2/6 post and insurance.

EX-GOVERNMENT VALVES

Many types in stock Here are some of the more popular ones:

1T4	7/6	6K8	9/6	954	3/6
1LD5	3/6	6L6	9/-	1625	10/6
2X2	4/6	6N7	7/6	DDT4	3/6
3A4	7/-	6SA7	8/-	DDT13	8/6
5Z4	9/6	6Q7	9/6	DH73	9/6
5U4	8/-	6SJ7	8/6	DL74	9/6
6AC7	6/6	6SK7	6/-	EF50	8/6
6AL5	6/6	6SL7	3/-	EL50	10/6
6B8	4/-	6V6	9/6	H63	6/6
6C4	6/6	7A7	9/6	HL4G	6/6
6C6	6/6	7V7	9/6	HL13	9/6
6D6	6/6	7Y4	8/6	HL1320	9/6
6F6	7/6	25Z4	9/6	KT61	9/6
6F8	9/6	25Z6	10/6	KT72	9/6
6G6G	4/6	25Y5	10/-	KTW61	4/6
6H6	2/6	42	8/-	KTW73	9/6
6J5	5/-	43	10/-	KTZ41	9/6
6J7	6/-	75	12/6	U12	8/6
6K6	7/-	77	8/6	U74	9/6
6K7	7/6	78	8/6	U71	9/6
		84	8/6		

Install those extra power points

Three core 7.029 P.V.C. insulated. Cores coloured red, blue and white. Outer covering of braiding compounded. Suitable for 3-phase or power extensions. **75/-** per coil of 100 yds., carriage 3/6.

NOW TWO MODELS TURRET TUNER

Brand new stock, not surplus, with coils for Band I and III, complete with valves. Model I. — I.F. output 33/38 mc/s. Series heaters. Model II. I.F. output 16-19 mc/s. Parallel heaters with circuit diagram, **79/6**. With knobs **3/6** extra, post and ins. 2/6.

14in. T.V. CABINET

14in. T.V. cabinet of the latest styling—beautifully veneered and polished—limited quantity—sale price **19/6** ea. Carr. and packing 3/6 extra. **Masks 10/- extra.**

F.M. TUNER

This is a high fidelity unit which although moderately priced has a performance equal to the highest priced. Its stability is very good and extremely good results have been received with the simplest of aerials as far away as Eastbourne. The unit is made up ready to work and has its own power supply for A.C. mains. Demonstration at all our branches. Price **12 gns.** or **£1/12/-** down and 6 payments of **£2**. Post plus insurance 5/-.

You can build our TV in one evening

There are only 24 solder joints to make —suitable 14in. or 17in. tube, cost **£29/10/-**. We will gladly send full constructional details and circuit diagram on receipt of 3/6 which will be credited in full if you buy the kit.

ELECTRONIC PRECISION EQUIPMENT, LTD.

Post orders are dealt with from Eastbourne, so for prompt attention please post your orders to 66 Grove Road, Eastbourne, marked Department 2.

42-46, Windmill Hill, Ruislip, Middx. Phone: RUISLIP 5780. Half day, Wednesday.

66, Grove Road, Eastbourne, Sussex. Half day, Saturday.

29, Stroud Green Rd., Finsbury Park, N.4. PHONE: ARChway 1049. Half day, Thursday.

266, London Road, Croydon. Phone: CRO 6558. Half day, Wednesday.

Reduce

your press tool costs

***with the* HUNTON**

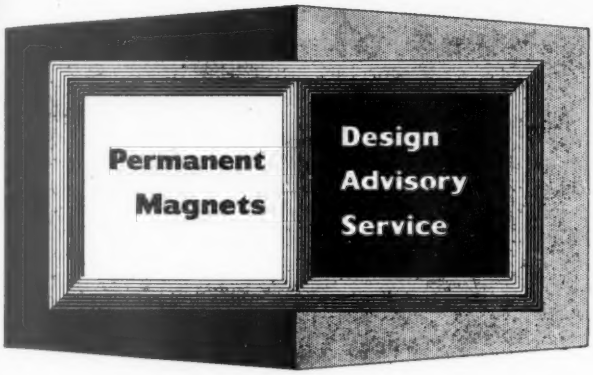
UNIVERSAL BOLSTER OUTFIT

Tools for piercing and forming louvres up to 8" long.
Standard Corner Notching Tool 2" square.
Relay Tools.
Tools for piercing apertures for Painton, Belling Lee, Plessey, etc., Plugs and sockets.
Punches and Dies for piercing valve holder holes.
Square, rectangular and slotting tools.

In addition to the range o. Punches and Dies ⅛" to 3¾" dia. available from stock, some of the tools usually required in the Radio and Electronic Industry have been standardised for use with the Hunton Universal Bolster Outfit. Illustrated above are a few which can be supplied quickly or from stock. In London and Home Counties, ask for a practical demonstration in your own works. Alternatively, write for illustrated price list W.W.1.

HUNTON LIMITED

PHOENIX WORKS, 114-116, EUSTON ROAD, LONDON, N.W.1. *Telephone: EUSton 1477*



No. 2

Magnetic Circuits

Advertisements in this series deal with general design considerations. If you require more specific information on the use of permanent magnets, please send your enquiry to the address below, mentioning the Design Advisory Service.

The fundamental factors governing the design of a magnetic circuit are:—

(*a*) The magnetic field strength required in the air gap.

(*b*) The physical dimensions of the air gap.

(*c*) The leakage flux from the surface of the magnet (and pole pieces, if used).

If the dimensions of the gap and the flux required in it are known, the length of the magnet may be determined with the aid of either of the following simple formulae.

c.g.s. System

Length L_m of magnet in cm.

$$L_m = \frac{H_g \times L_g}{H_d} \times K_l$$

H_g is the field in the air gap in oersteds; L_g is the length of the air gap in cm; H_d is the design value of H from the magnet material characteristic.

M. K. S. System

Length L_m of magnet in metres

$$L_m = \frac{B_g \times L_g}{H_d} \times 4\pi \times 10^{-7} \times K_l$$

B_g is flux density in gap in webers/metre²; L_g is length of gap in metres; H_g is in ampère-turns/metre.

K_l is a factor which may vary between 1.05 and 1.2. The lower value would apply if iron is of good magnetic quality operating well below saturation; also if joints in the magnetic circuit do not present appreciable reluctance.

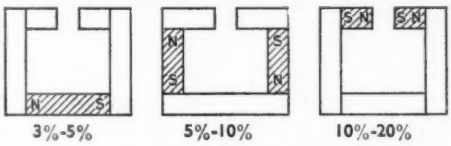
The cross-sectional area of the magnet may be obtained by this formula.

Area A_m of magnet in sq. cm.

$$A_m = \frac{B_g \times A_g}{B_d} \times \text{Leakage Factor}$$

B_g is the flux density required in the air gap ($B_g = H_g$ in air); A_g = area of gap in sq. cm.; B_d = design value of flux density of the magnet material.

Leakage factors vary enormously with different applications and therefore, some experience or information is necessary in order to get a sufficiently close approximation for practical purposes. An example illustrating leakage is shown below.



3%-5% 5%-10% 10%-20%

APPROX. EFFICIENCY

Using the M. K. S. System the same formula still applies with B_g and B_d in webers/metre² and the area in square metres.

If you wish to receive reprints of this advertisement and others in this series write to the address below.

Mullard

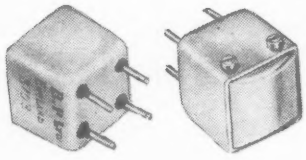
'TICONAL' PERMANENT MAGNETS
'MAGNADUR' CERAMIC MAGNETS
FERROXCUBE MAGNETIC CORES

MULLARD LIMITED, COMPONENT DIVISION, MULLARD HOUSE, TORRINGTON PLACE, W C.1 Tel. LANgham 6633
MC 262A

BRADMATIC PRODUCTIONS LTD.....

ANNOUNCE

The "SIMPLEX" SOUND HEAD



Quantity production of the new "Simplex" Record-Playback Head has now commenced. This is a Head of novel design—superior in performance and competitive in price.

Specification capable of amendment to suit most requirements.

ENQUIRIES INVITED FOR QUANTITY QUOTATIONS

Sales Office:— 28 SOHO HILL, B'HAM, 19. Nor. 8091

ASK ARTHURS FIRST

LARGE STOCKS OF VALVES and C.R.T.s. METERS, Avo, Advance, Taylor and Cossor Oscilloscopes in stock. AMPLIFIERS, Leak, Trix & Quad. GRAM UNITS, Garrard & Collaro. Collaro TRANSCRIPTION UNIT 2010PX.

LOUDSPEAKERS, Goodmans, Wharfedale, WB Tannoy and leading makes. PICK-UPS and STYLI of most makes. TAPE RECORDERS, Grundig, Philips, Truvox, Playtime & Ferrograph.

LATEST VALVE MANUALS

Mullard, 10/6; Osram & Brimar No. 6, 5/- each; Osram Part 2, 10/-.

Postage 9d. each extra.

PARTICULARS ON REQUEST

Terms C.O.D. OR CASH with order.

Arthurs EST. 1919

PROPS: ARTHUR GRAY, LTD.

GRAY HOUSE 150-152 CHARING CROSS ROAD, LONDON, W.C.2

TEMple Bar 5833/4 and 4765 Cables: TELEGRAY, LONDON

TRANSFORMERS
COILS
CHOKES

LARGE OR SMALL QUANTITIES

TRADE ENQUIRIES WELCOMED

SPECIALISTS IN

FINE WIRE WINDINGS

MINIATURE TRANSFORMERS, PICK-UP
CLOCK AND INSTRUMENT COILS, ETC.
VACUUM IMPREGNATION TO APPROVED STANDARDS

ELECTRO-WINDS LTD.

CONTRACTORS TO G.P.O., M.O.S., L.E.B., ETC

123-5-7 PARCHMORE ROAD, THORNTON HEATH, SURREY

LIVINGSTONE 2261 EST 1933

THE WORLD'S GREATEST BOOKSHOP

FOYLES

* * FOR BOOKS * *

FOR ALL YOUR

Technical Books

'Foyles is an experience—the largest bookstore on earth. If you're a lover of books, large or small, modern or rare, here's Paradise'

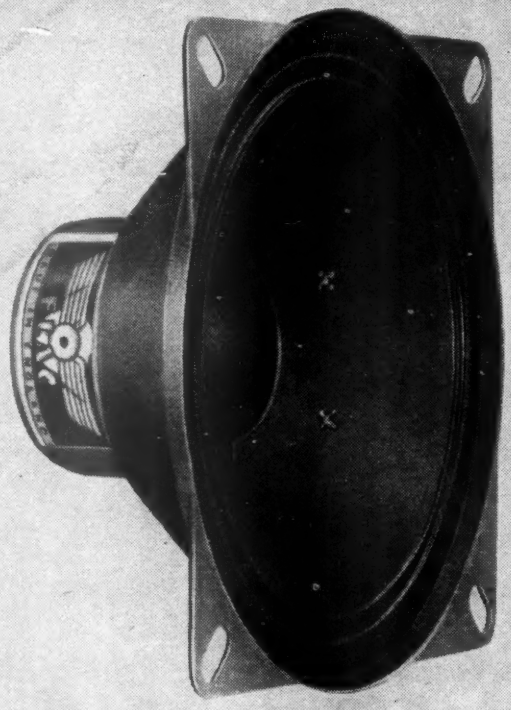
—*Fielding's Guide to Europe*

119-125 CHARING CROSS ROAD, LONDON W.C.2

Gerrard 5660 (20 lines) ★ *Open 9-6 (Thurs. 9-7)*

Nearest Station: Tottenham Court Road

The latest in the Hi-Fi range



The Elac 4 inch Tweeter

A further addition to the "Elmag" High Fidelity range, this 4in. cone type Tweeter is the finest of its class yet produced. Response to transients is exceptionally good and the absence of undesirable peaks results in clear and smooth reproduction.

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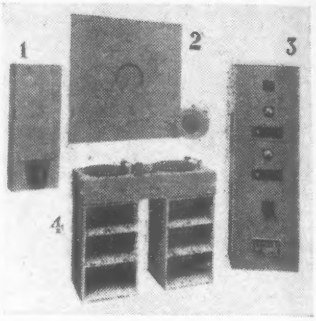

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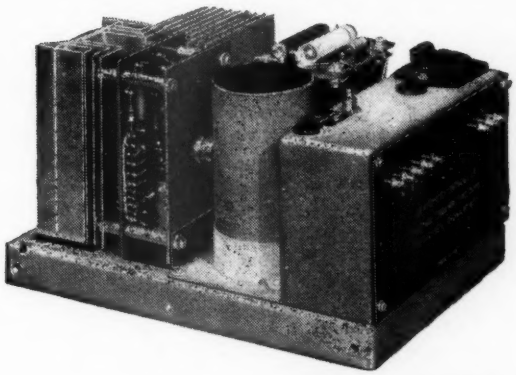

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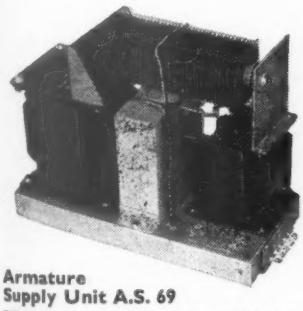

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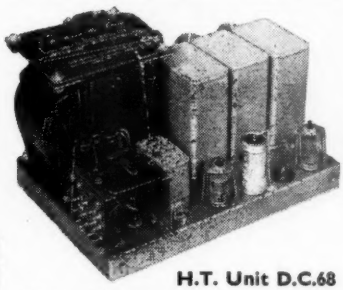

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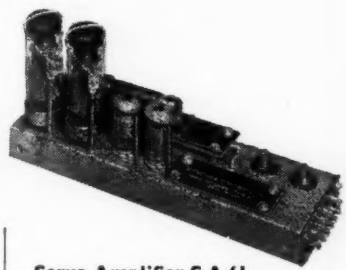

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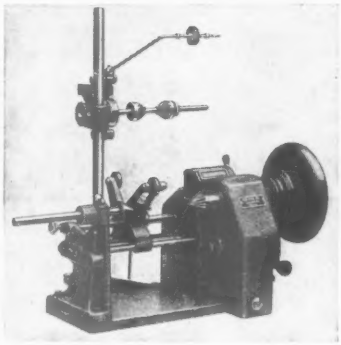

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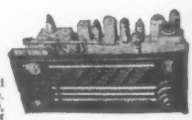

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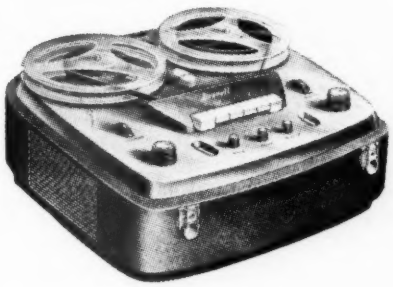

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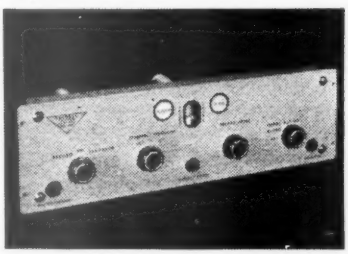

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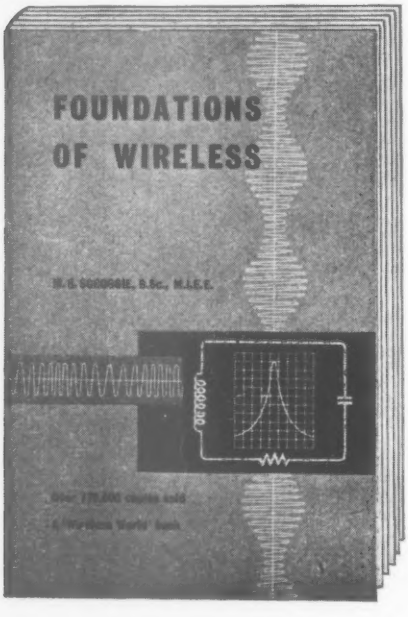

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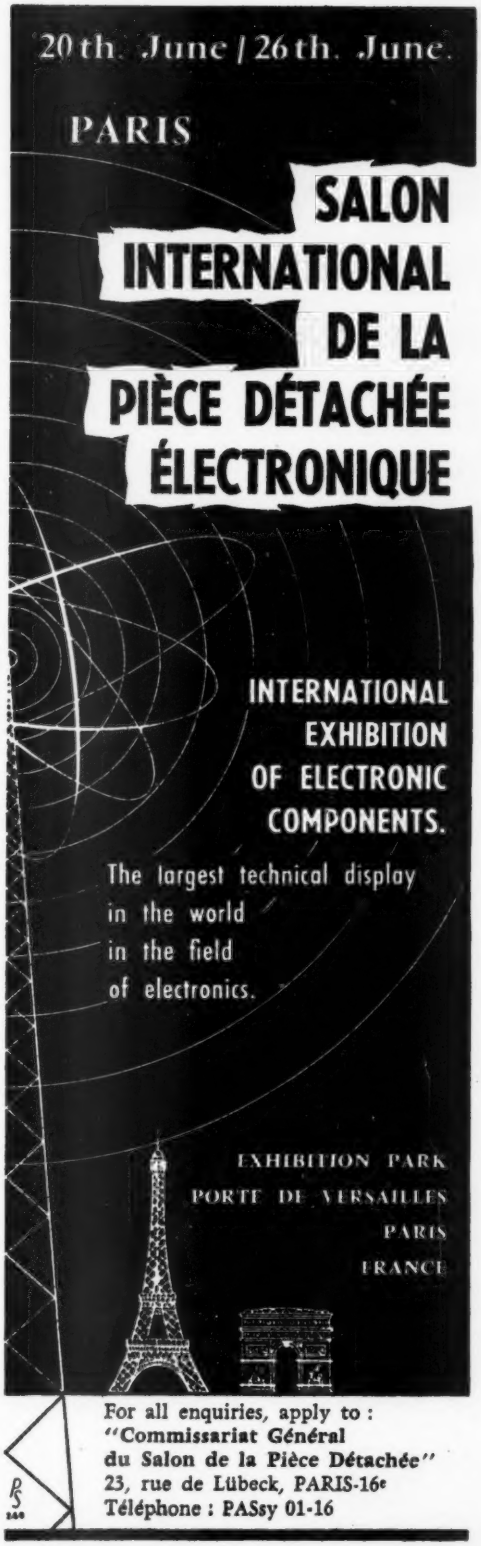
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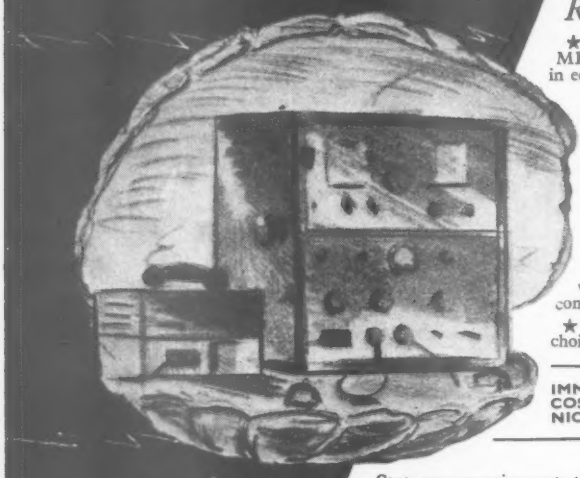

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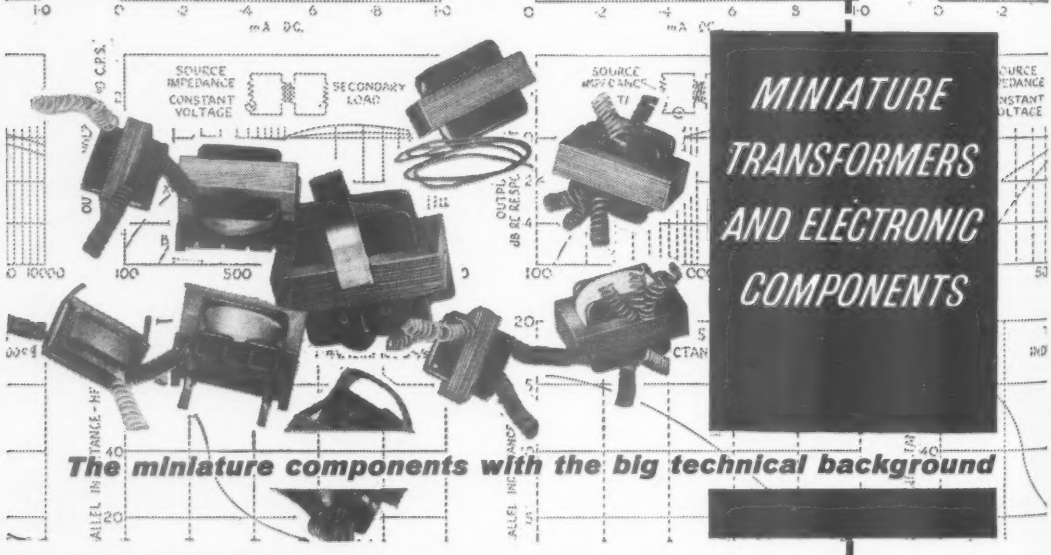

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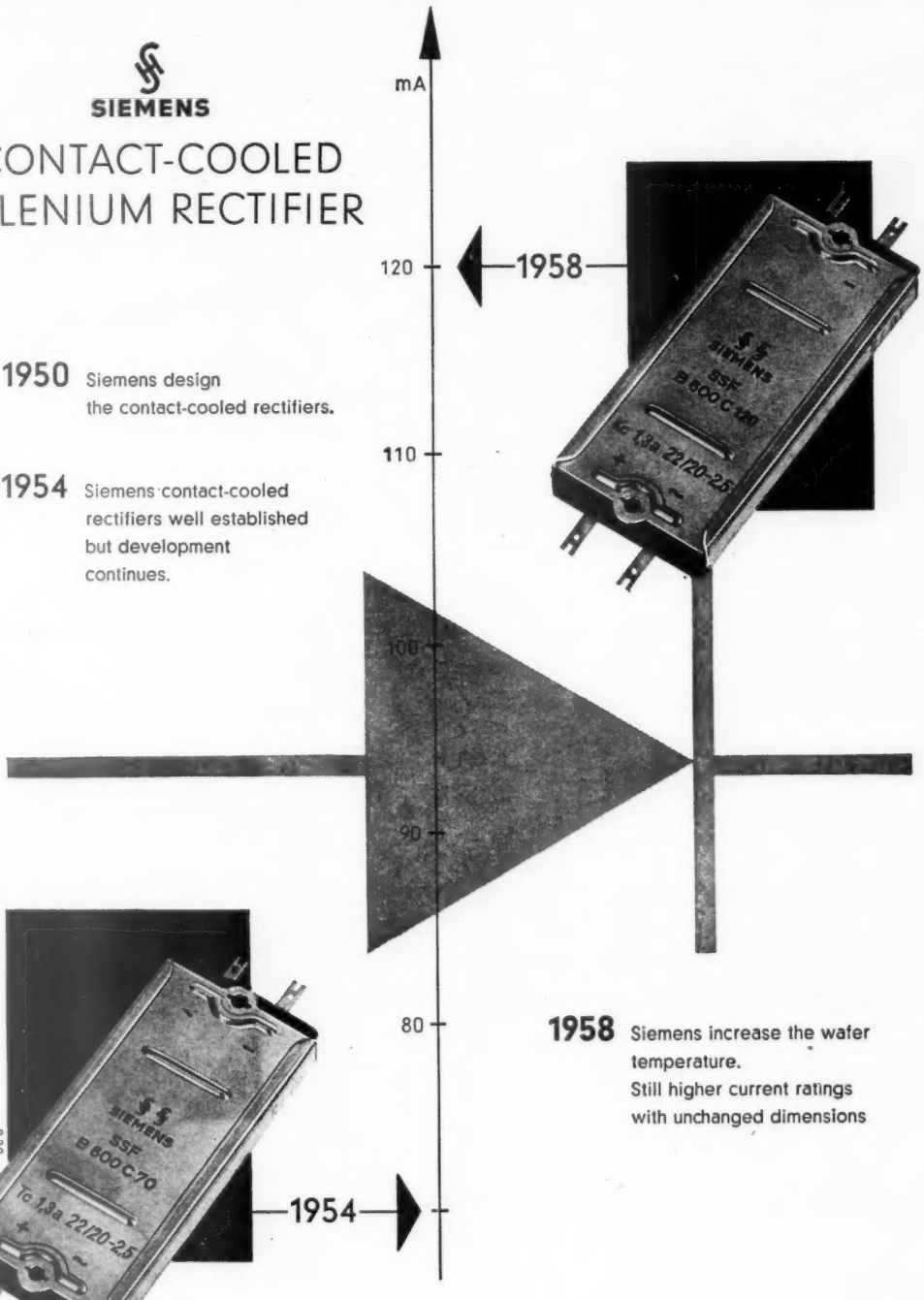

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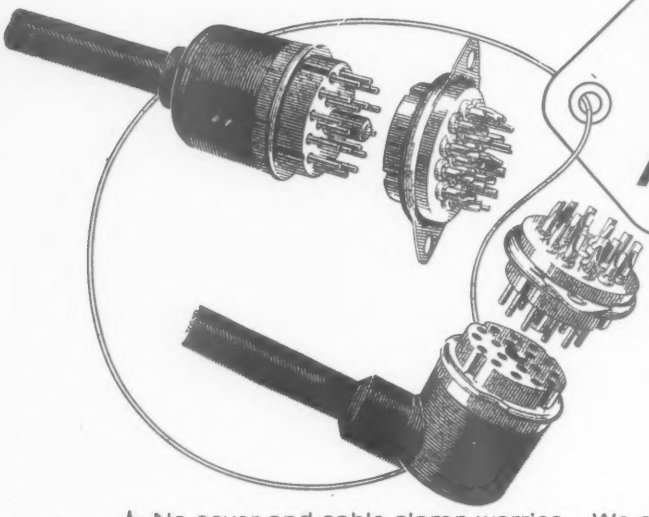

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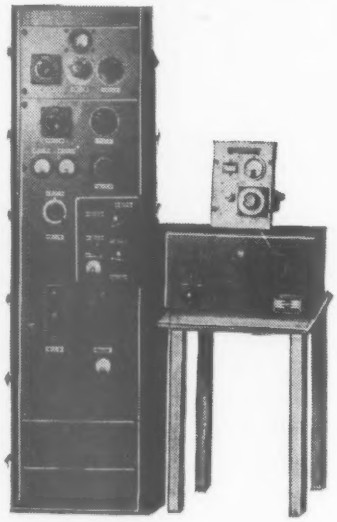
FAMOUS RCA TRANSMITTERS
TYPES ET 4336, K & L



Frequency 2 mc.-20 mc.
Power output: 350 w. telegraph.
250 w. telephone.
Type of modulation—Class B high level.
Audio input impedance 500 ohms.
Power supply 190 to 250 v. single phase 50-60 c.
Tube complement: Crystal oscillators—807, Master oscillators—807, Intermediate amplifier—807, Power amplifier—813(2), Modulator—805(2), Rectifier—866A(4).
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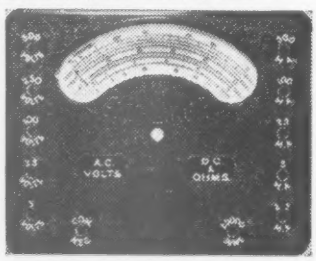

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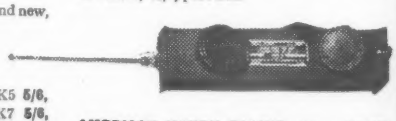
BCR522 TRANSMITTER (BC625), including all valves, **45/-,** post free.



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BC375, complete with T/U's, PE73, etc
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for Oscillography

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The 4GP, 5BHP and 6EP cathode ray tubes are only three of a wide range of instrument tubes marketed by the G.E.C.

The range includes both electromagnetic and electrostatic deflection tubes and all are generally available with any one of six standard screen phosphors. Other screen phosphors can be supplied to special order.

Should you have any cathode ray tube problems—consult the M-O Valve Company. You will most probably find a tube in the range which is ideally suited to your particular application. If not, the Company with its wealth of experience and technical facilities may be able to make a special tube for you.

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Product of
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A subsidiary of THE GENERAL ELECTRIC CO. LTD.

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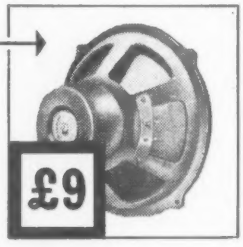
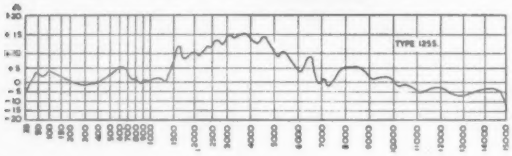
. . . you will realise that Grampian high fidelity equipment gives you the nearest approach to "Concert Hall listening" in your own home. You will, for instance, appreciate the extraordinary delicacy of reproduction achieved by their new 12in. loudspeaker. A great deal of research and new manufacturing methods were necessary to produce a speaker unit with such an extended audio frequency coverage at such a reasonable cost.

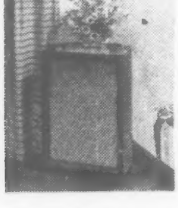
GRAMPIAN
12" SPEAKER UNIT
Type 1255/15



Frequency Range.....20-15,000 c.p.s
Voice Coil Diameter.....1⅞in.
Voice Coil Impedance.....15 ohms
Fundamental Resonance.....40 c.p.s.
Power Handling Capacity.....10 watts
Flux Density: 14,500 lines per sq. cm.
Total Flux: 130,500 lines per sq. cm.



CYCLES PER SECOND INPUT ½ WATT
RESPONSE CURVE for speaker unit 1255/15



A specially designed reflex cabinet suitable for either corner or side of room is now available as an easy-to-assemble kit of parts, complete with grille material ready to assemble, stain and polish. Although it is primarily intended for use with the Type 1255/15 speaker the cabinet will give excellent results with other units of similar specifications. Price £11

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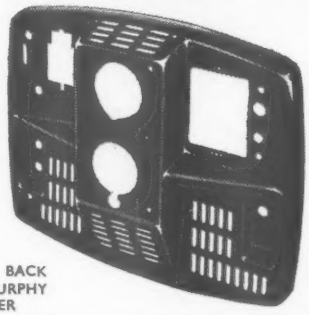

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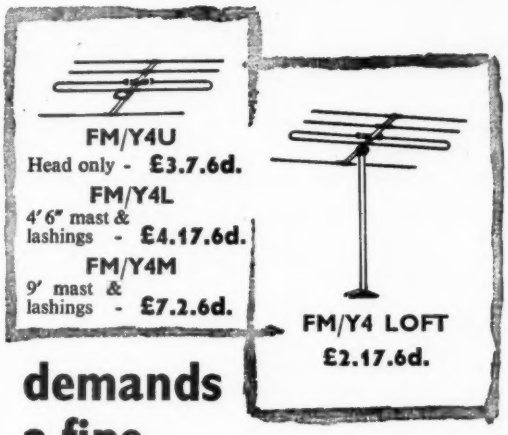

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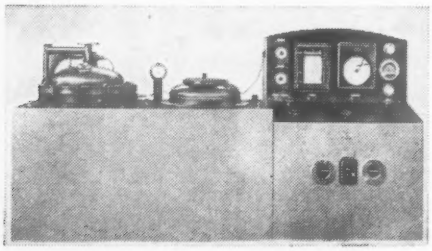

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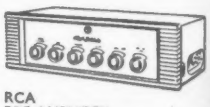
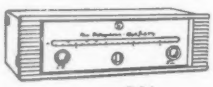
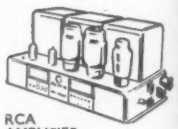

RCA PRE-AMPLIFIER CONTROL UNIT


RCA F.M. TUNER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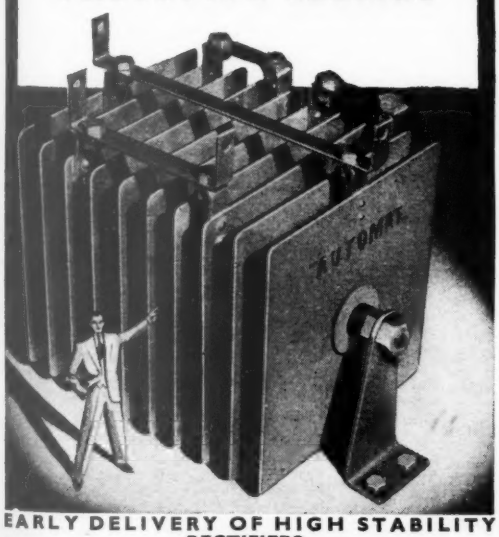

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EAF42	10/6	EL33	20/2	P61	3/6	UCC84	20/11	1N5	10/6	6F6M	7/6	7Q7	9/-	30P12	12/6
EB34	2/-	EL38	27/10	PC84	10/-	UCF80	23/-	1R5	8/-	6F13	14/-	7S7	9/6	35L6GT	9/6
EB41	9/6	EL41	10/6	PC88	13/6	UCH42	10/6	1S4	10/6	6F15	14/-	7Y4	8/6	35W4	8/6
EBC33	7/6	EL42	12/-	PCC84	10/-	UCH81	11/6	1S5	7/6	6F33	7/6	8D2	2/9	35Z4GT	8/-
EBC41	10/6	EL84	10/6	PCF80	13/6	UCL82	23/-	1T4	7/6	6G6G	4/6	9D2	3/6	35Z5GT	9/-
EBF80	10/6	EM34	10/6	PCF82	12/6	UCL83	25/9	2C26	1/6	6H6	2/6	10F1	27/10	42	8/-
EBF89	18/1	EM80	10/6	PCL82	14/6	UF41	10/6	2X2	4/6	6H6GT	2/6	12A6	6/6	50C5	11/6
EBL21	24/4	EM81	11/6	PCL83	14/6	UF85	10/6	3A4	7/-	6J5GT	5/6	12AH8	11/6	50CD6G	31/4
EBL31	24/4	EY51	13/6	PL38	27/10	UF89	10/6	3D6	5/-	6J5M	6/6	12AT6	10/6	50L6GT	8/6
EC52	6/-	EY86	17/6	PL81	16/-	UL41	10/6	3Q4	9/-	6J6	6/-	12AT7	9/-	75	11/6
ECC40	12/6	EZ40	9/-	PL82	9/6	UL44	27/10	3Q5GT	9/6	6J7G	6/6	12AU7	7/6	77	7/6
ECC84	10/3	EZ41	10/-	PL83	11/6	UL46	24/4	3S4	8/-	6J7M	9/-	12AX7	8/6	80	8/6
ECC85	9/6	EZ80	8/9	PL84	9/6	UL84	11/6	3V4	9/-	6K6GT	7/-	12BA6	9/-	142BT	3/6
ECF80	13/6	EZ81	11/10	PL85	10/6	UU6	20/11	4D1	3/-	6K7G	5/-	12BE6	10/-	185BT	34/9
ECF82	12/6	EZ90	8/-	PL86	10/6	UU8	27/10	5R4GY	9/6	6K7GT	7/-	12BH7	11/6	210DDT	4/6
ECH21	24/4	E1148	2/-	PL95	8/6	UU9	8/6	5U4G	8/-	6K7M	6/9	12C8GT	8/-	210VPT	3/6
ECH35	10/6	GZ32	12/-	PL504	27/10	UY41	8/6	5Y3G	8/-	6K8G	8/6	12H6GT	3/-	807	4/6
ECH42	10/-	H30	5/-	PL505	27/10	UY85	10/-	5Y3GT	8/-	6K8GT	9/6	12J5GT	4/6	954	2/-
ECH81	9/-	HL23DD	8/6	PY80	9/-	VP2B	8/-	5Z4G	10/-	6K25	20/11	12J7GT	10/6	955	4/9
ECL80	13/6	K40N	9/-	PY81	10/-	VP23	6/6	6A7	13/-	6L6G	9/-	12K7GT	8/6	956	3/6
ECL82	12/6			PY82	8/6	VP41	8/6	6A8G	10/-	6L7	7/6	12K8GT	13/6	9001	5/6
				PY83	10/-	VR105/30	6/6	6AC7	6/6	6N7	7/6	12Q7GT	8/6	9002	5/6
				PZ30	20/11	VR116	4/-	6AG5	5/6	6P25	13/6	12SC7	2/6	9003	5/6
				PEN4DD	27/10	VR150/30	9/-	6AK5	6/6	6P28	27/10	12SG7	7/6	9004	5/6
				PEN25	5/-	VS70	3/-	6AL5	6/6	6Q7GT	9/-	12SH7	5/6	9006	5/6
				PEN44	27/10	VU120A	3/6	6AM6	9/-	6SA7GT	8/-	12SJ7	8/-		
				PEN45	27/10	VU39 (MU12/14)	8/9	6AQ5	7/6	6SG7	7/6	12SK7	6/-		
				PEN46	7/-			6AT6	8/6	6SH7	6/-	12SL7	8/-		
				PEN220A	4/-			6AU6	10/6	6SJ7	8/6	12SN7GT	17/6		
				PENA4	15/-	VU111	2/6	6B4	5/-	6SK7	6/-	12SQ7	8/6		
				QP21	7/6	W77	8/6	6B8G	4/-	6SL7GT	8/-	14S7	14/6		
				R16	27/10	W729	13/6	6BA6	7/6	6SN7GT	7/6				
				R19	13/6										
				SP41	3/-										
				SP61	3/-										
				SP220	3/11										
				T41	24/4										
				TH2	9/-										

LOUDSPEAKER CABINETS

This attractive walnut-finished cabinet is available for 6½in. or 8in. speaker units. Metal speaker fret, complete with back and rubber feet.

6½in. type. Measures 8½in. × 8½in. × 4½in. at base. Price **17/6** each.

8in. type. Measures 10½in. × 10½in. × 5in. at base. Price **21/6** each.

5in. type. Very similar design. Price **16/6** each. Postage, any type, 2/- each.

MAINS TRANSFORMERS

5-Way Mounting Type.

MT1
Primary: 200-220-240 v. Secondaries: 250-0-250 v. 80 m/A 0-6.3 v. 4 amp. 0-4 v. 2 amp. Both tapped at 4 v., **21/9** each.

MT2
Primary: 200-220-240 v. Secondaries: 350-0-350 v. 80 m/A 0-6.3 v. 4 amp. 0.5 v. 2 amp. Both tapped at 4 v. **21/9** each.

MT3
Primary: 200-220-240 v. Secondary: 30 v. 2 amps. Taps at 3 v., 4 v., 6 v., 8 v., 9 v., 10 v., 15 v., 18 v., 20 v., 24 v., **21/9** each. Postage and Packing please add 2/- per transformer.

HEATER TRANSFORMERS Each

230 v. Input 2 volt .5 amp.	5/-
230 v. Input 2 volt 3.0 amp.	8/3
230 v. Input 4 volt 1.5 amp.	5/6
230 v. Input 4 volt 3.0 amp.	10/-
230 v. Input 5 volt 2.0 amp.	10/-
230 v. Input 6.3 volt .5 amp.	5/6
230 v. Input 6.3 volt 1.5 amp.	6/9
230 v. Input 6.3 volt 3.0 amp.	10/-
230 v. Input 12 volt .75 amp.	5/9

SOLID DIELECTRIC CONDENSERS. .0001, .0002, .0003, .0005, **4/6** each.

EM80 Type TUNING INDICATORS Escutcheon, **2/-** each.

AVO MINOR CASE with carrying strap, **7/6** each.

The BRAYHEAD TURRET CONVERTOR. Comprehensive installation instructions, plug-in facilities for over 600 popular models of TV sets of standard I.F. ranges. Price **27/7/-** each. Illustrated leaflets available. Adaptors, **7/6** each.

IMPLOSION GUARDS for 17in. tubes, outside dimensions 17½in × 12½in. Brown escutcheon, **7/6** each. Postage 3/-.

WB "Stentorian."
Model HF 812 die-cast chassis, **84/6** each. Model HF 1012 die-cast chassis, **99/9** each. Universal speech coils.

CO-AXIAL CABLES, ETC.
Aerialite Aeraxial 597, semi - airspaced, **9d.** yard.
Ashton Co-axial cable, solid, **6d.** yard.
Ashton feeder (Flat), 300 ohms, **6d.** yard.

12 YAXLEY-TYPE SWITCHES, various combinations, all brand new, **9/-** doz.

Full-range CONDENSERS available from stock. Cardboard covered wire-ended types.

TCC 10 mfd. 450 v.	1/11
Dubilier 8 mfd. 500 v.	2/9
BEC 8 × 8 mfd. 450 v.	4/-
BEC 16 mfd. 450 v.	2/3
BEC 16 × 8 mfd. 450 v.	4/-
BEC 16 × 16 mfd. 450 v.	4/6
BEC 32 mfd. 450 v.	3/-
BEC 32 × 32 mfd. 350 v.	4/6
Dubilier 16 × 16 mfd. 500 v.	5/-
Dubilier 8 × 8 mfd. 500 v.	4/-
Dubilier 16 × 8 mfd. 500 v.	4/-

STANDARD CAN TYPES:

24 × 24 × 16 mfd. 350 v.	3/9
32 × 32 mA. 450 v.	6/6
60 × 60 mfd. 350 v.	4/6

These are just a few of the types—good stocks of low voltage electrolytics, etc., etc.

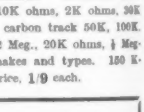
CHASSIS. Aluminium, undrilled with reinforced corner. Available in the following sizes:—

Each		Each
6 × 4 × 2½in. 4/6	12 × 8 × 2½in.	8/6
8 × 6 × 2½in. 6/3	14 × 3 × 2½in.	6/-
10 × 7 × 2½in. 7/3	14 × 9 × 2½in.	10/-
12 × 3 × 2½in. 5/9	16 × 6 × 2½in.	8/6
12 × 5 × 2½in. 6/9	16 × 10 × 2½in.	14/-

All are four-sided—ideal for radio receivers—amplifiers—power packs, etc.

PRE - SET CONTROLS. Available wire wound, 1K and 10K ohms, 2K ohms, 30K ohms. Available carbon track 50K, 100K, ½ Meg., 1 Meg., 2 Meg., 20K ohms, ½ Meg. ohms. Various makes and types. 150 K-ohms. All one price, **1/9** each.

LOUDSPEAKER UNITS



Make	Type	Size	Price
Plessey	Square	3in.	.... 19/6 each
Lectrona, Plessey	Round	5in.	.... 17/6 each
Goodmans, Plessey	Round	6½in.	.... 18/6 each
Goodmans, E. & A.	Round	8in.	.... 19/6 each
Plessey, E. & A., Elac	Round	10in.	.... 25/6 each
Elac	Elliptical	7in. × 4in.	19/6 each
Elac	Elliptical	10in. × 6in.	25/6 each

All the above are PM units with 2 to 3 ohms speech coils.

RTC 12in. heavy duty 20 watts model, 15 ohms Speech Coil £5 5 0
8in. Mains Energised Speaker £1 0 0

6½in. Mains Energised Speaker 17 6
8in. Mains Energised Speaker £1 1 0
All have field coils of approx. 600 ohms.

SPECIAL OFFER
Just a few 8in. units by Goodmans and Lectrons fitted with standard output transformer ..... £1 1 6 each
8in. P.M. Speaker Units with Output Transformer removed from equipment **11/6** each

OUR 1957-1958 CATALOGUE IS NOW AVAILABLE TO ALL READERS OF THIS MAGAZINE. 48 PAGES OF COMPONENTS AND EQUIPMENT OF INTEREST TO ALL RADIO ENTHUSIASTS. SEND 1/- IN STAMPS FOR YOUR COPY.

ALPHA RADIO SUPPLY CO.

103, LEEDS TERRACE, WINTOUN STREET, LEEDS, 7.

TERMS: Cash with order or C.O.D. Postage and Packing charges extra, as follows: Orders value 10/- add 1/-; 20/- add 1/6; 40/- add 2/-; £5 add 3/- unless otherwise stated. Minimum C.O.D. fee and postage 3/-.
For full terms of business see inside cover of our catalogue.
Personal Shoppers 9 a.m. to 5 p.m. Mon. to Friday. Saturday 10 a.m. to 1 p.m.

AND NOW THERE ARE TWO

Stern's "fidelity" TAPE RECORDERS

PRICE . . . Including CRYSTAL MIKE and 1,200ft. reel of PLASTIC TAPE.

£49.10.0 (OR £3 EXTRA WITH REV. COUNTER.)

CREDIT SALE: Deposit £12/8/- and 9 monthly payments of £4/10/8.
HIRE PURCHASE: Deposit £24/15/- and 12 monthly payments of £2/5/11.

IT INCORPORATES: The NEW TRUVOX Mk. IV TAPE DECK together with the "fidelity" MODEL HF/TR2 TAPE AMPLIFIER (both fully described on this page), and a Rola 10in. x 6in. P.M. speaker.

PRICE . . . Including CRYSTAL MIKE and 1,200ft. reel of PLASTIC TAPE.

"JUNIOR"

39GNS.

CREDIT SALE: Deposit £10/5/- and 9 monthly payments of £3/15/2.
HIRE PURCHASE: Deposit £20/10/- and 12 monthly payments of £1/18/-.

IT INCORPORATES: THE TRUVOX MK. III TAPE DECK together with correctly matched HF/TR1A TAPE AMPLIFIER and a 7in. x 4in. Speaker.

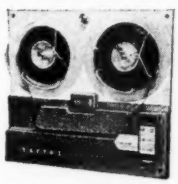
(Plus £1/10/- carriage and insurance, of which £1 is refunded on return of Packing Case.)

BEFORE CHOOSING YOUR TAPE RECORDER YOU SHOULD HEAR THESE MODELS—TRULY "Hi-Fi" RECORDINGS ARE OBTAINABLE and they are comparable to much higher-priced Recorders.

Alternatively send S.A.E. for ILLUSTRATED LEAFLET

THE NEW TRUVOX Mk. IV TAPE DECK

ONE OF THE BEST DECKS ON THE MARKET



PRICE £27.6.0 (Plus 10/- carr. and ins.)

CREDIT TERMS: Deposit £6/17/- and 9 monthly payments of £2/10/-.
H.P. TERMS: Deposit £13/13/- and 12 monthly payments of £1/5/4.

SPECIFICATION:— ● 3 B.T.H. shaded pole motors with silent friction drive eliminating wow and flutter. ● Push-button controls, electrically and mechanically interlocked (patented). ● Patented electric-type push-button controlled brake. ● Inching to assist editing; tape loading on the drop-in principle; accommodation for reels of 7in. diameter. ● Tracking sense. To British and American standards. ● Playing times: Up to 3 hours with L.P. Tape or 2 hours with Standard Tapes. ● Two tracks side by side. With safety gap. ● Playing time indication by precision revolution counter of large visual type indicator plate, according to choice. Positive Azimuth adjustment of Record/Player Head. ● High Impedance Heads. ● The metal work is Gold Hammered finish. ● Overall size 14½in. x 12½in., from top of face of panel, overall depth 5in.

The Mk. IV DECK CAN ALSO BE SUPPLIED INCORPORATING PRECISION REV. COUNTER for £30/9/-. H.P. TERMS: Deposit £15/4/6 and 12 months of £1/8/3.
CREDIT SALE: Deposit £7/12/3 and 9 months of £2/15/10.

A COMPLETE KIT OF PARTS TO BUILD

The "fidelity" TAPE AMPLIFIER Model HF/TR2 including POWER SUPPLY UNIT

This amplifier has been expressly designed to meet the requirements of the enthusiasts for High Fidelity reproduction. It is based on the very successful design, completed by the Mullard Technicians and only really high-grade components are incorporated; truly HIGH FIDELITY Recordings are obtainable whilst "Hi-Fi" reproduction is assured by use of a high-quality Output Transformer by Gilson. It incorporates a "magic eye" Recording Level indicator, a two-position equaliser for 3¾in. and 7½in. speeds, and an effective Tone Control arrangement. Monitoring and Extension Speaker Socket are incorporated and in addition a position is provided to enable it to be used as an independent Amplifier for Gramophone Records or Radio Tuning Unit. Overall size: 11in. x 6in. x 6in. high. Suitable for nearly all makes of Tape Decks. When ordering, please advise make of deck in use.

FOR ONLY £12.0.0 (Plus 5/- carr. and ins.)

THE ASSEMBLY MANUAL PRACTICAL DIAGRAMS, etc., are available for 2/9 or send S.A.E. for brief details.

WE ALSO SUPPLY THE HF/TR2 ASSEMBLED AND READY FOR USE FOR £16.0.0 (Plus 6/- carr. and ins.). H.P. TERMS: Deposit £8 and 9 monthly payments of £1. CREDIT TERMS: Deposit £4 and 9 monthly payments of £1/9/4.

HOME CONSTRUCTORS

BUILD YOUR OWN RECORDER . . . WE OFFER

(a) The model HF/TR2 AMPLIFIER and POWER UNIT, both fully assembled, together with the TRUVOX MK. IV TAPE DECK for £38 10 0
ALTERNATIVELY as above but the HF/TR2 Amplifier and P/Unit as a COMPLETE KIT OF PARTS £35 0 0

(b) The model HF/TR2 AMPLIFIER and POWER UNIT both fully assembled, together with the TRUVOX TAPE DECK incorporating PRECISION REV. COUNTER £41 10 0
ALTERNATIVELY as above but the HF/TR2 Amplifier and P/Unit as a COMPLETE KIT OF PARTS £38 0 0

(c) The model HF/TR2 AMPLIFIER and POWER UNIT, both fully assembled, together with the COLLARO TRANSCRIPTOR £35 0 0
ALTERNATIVELY as above but the HF/TR2 Amplifier and P/Unit as a COMPLETE KIT OF PARTS £31 10 0
plus 12/6 carriage and insurance.

TO COMPLETE THE RECORDER . . . WE OFFER

The Portable Carrying Case . . . Acos
Crystal Mike . . . Rola 10in. x 6in. P.M.
SPEAKEE . . . 1,200ft. Plastic Tape.

ALL FOR **£8.10.0** (plus 7/6 Carr. & Ins.)

STERN'S TAPE PRE-AMPLIFIER and ERASE UNIT

Provides the 'Link' between the HIGH-QUALITY AMPLIFIER & TAPE DECK MODEL HF/TR1P . . . A completely assembled Pre-Amplifier with own Power Supply. Can be supplied correctly matched for use with Truvox or Collaro Decks, and incorporates Recording Level Indicator and Monitoring facilities.
Please send S.A.E. with any inquiry.

PRICE **£11.10.0** (plus 5/- carr. and insurance)

WE MAKE SPECIALLY REDUCED PRICES FOR COMBINED ORDERS

ADD TAPE TO YOUR EXISTING AMPLIFIER . . . WE OFFER YOU

(a) The Model HF/TR1P TAPE PRE-AMPLIFIER together with the TRUVOX MK. IV TAPE DECK £35 0 0
(b) ALTERNATIVELY as in (a) above but Truvox Deck incorporating PRECISION REV. COUNTER £38 0 0
(c) The model HF/TR1P TAPE PRE-AMPLIFIER together with the COLLARO TRANSCRIPTOR Tape Deck £31 10 0

PLEASE INCLUDE 12/6 to cover cost of carriage and insurance.

HIRE PURCHASE and CREDIT SALE TERMS are available on all equipment (excluding Kits of Parts). Send S.A.E. for details.
NOTE . . . The Collaro Transcriptor is in short supply and there may be a delay in delivery. We will however book an order.
The Deck switches of the Transcriptor have to be "wired-up." We will complete this wiring, for use with either the HF/TR2 or the HF/TR1P, for an extra charge of £1.

Open Monday to Friday 9 a.m.—6 p.m. Saturday 9 a.m.—1 p.m.

STERN RADIO LTD.

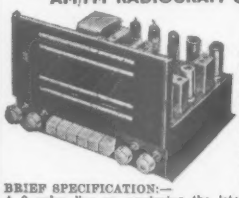
(DEPT 109/W)

109 & 115 FLEET ST., LONDON, E.C.4

Telephone: FLEet St. 5812/3/4

IT'S MUCH BETTER — MODERNISE YOUR OLD RADIOGRAM — IT'S MUCH CHEAPER

THE NEW ARMSTRONG P.B.409 AM/FM RADIOGRAM CHASSIS



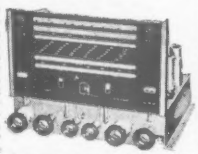
PRICE **£29.8.0** (Plus 7/6 carr. and ins.).

TERMS: Credit Deposit £7/7/- and 9 monthly payments of £2/14/-. H.P. Dep. £14/14/- and 12 monthly payments of £1/7/3.

BRIEF SPECIFICATION:—
A 9 valve line up employing the latest MULLARD preferred-type valves. ● Provides complete coverage of the VHF/FM Transmissions, plus the SHORT, MEDIUM and LONG waves. ● Has Push-Pull output, with negative feedback, for 6 watts Peak output. ● Quick action "Piano Jey" Selectors and separate Bass and Treble Controls. ● Has "Magic Eye" Tuning Indicator. ● Dimensions 13in. × 9½in × 8in. high. Dial size 11½in. × 5½in.

THE ARMSTRONG MODEL A.F. 105 AM/FM RADIOGRAM CHASSIS

A Genuinely Hand Made Chassis

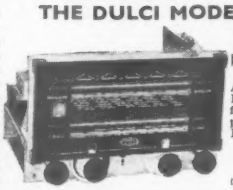


Developed to meet the needs of those who require really high quality radio and record reproduction but who, for reasons of expense or lack of room in existing or proposed cabinets, cannot consider the normal high-fidelity system. The A.F.105 is as good as, or better than many of the high quality amplifiers, and Associated units. Independent and continuously variable Bass and Treble controls give a wide range of control. **SEND S.A.E. FOR DETAILS.**

PRICE **£37** (Plus 7/6 carr. and ins.).

CREDIT SALE TERMS: Deposit £9/5/- and 9 monthly payments of £3/7/10.
HIRE PURCHASE TERMS: Deposit £18/10/- and 12 monthly payments of £1/14/4.

THE DULCI MODEL H.4



COMBINED AM/FM RADIOGRAM CHASSIS

A 4 Waveband Receiver designed for first-rate reproduction of Radio and Gram.

PRICE **£24.6.6** (Plus 7/6 carr. & ins.).

CREDIT TERMS: Deposit £6/2/- and 9 monthly payments of £2/4/7. H.P. TERMS: Deposit £12/3/3 and 12 monthly payments of £1/2/7.

BRIEF SPECIFICATION:—
- Covers Short, Medium, Long and F.M. Wavebands.
- Employs full A.V.C.
- The latest 7-valve line-up.
- For 3 or 15 ohm F.M. Speakers.
- "Magic Eye" Tuning Indicator.
- Excellent Tone range up to 4 watts output
- Internal aerial for local stations.
- Overall size 12in. × 8½in. × 7½in. high.

A good Quality Chassis and Well Recommended.

THE DULCI MODEL H.4T

Combined AM/FM Tuning Unit incorporating own Power Supply.

MODEL H.4T. This model is the "TUNER UNIT VERSION" of the H.4 Radiogram Chassis illustrated and described above. It has the same coverage of A.M. and F.M. Wavebands (4 altogether) and precisely the same in size and appearance, except that it has three Controls only, being: TUNING, WAVECHANGE and Volume On/Off, mounted centrally on the chassis. A self-contained Tuner incorporating own Power Supply.

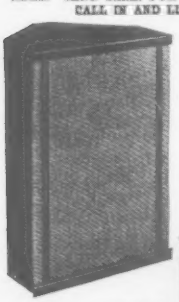
PRICE (plus 7/6 carr. & ins.) **£20.17.0**

CREDIT TERMS: Deposit £5/4/3 and 9 monthly payments of £1/18/4. H.P. TERMS: Deposit £10/8/6 and 12 monthly payments of 19/4.

HOME CONSTRUCTORS !!
BUILD YOUR OWN "Hi-Fi" LOUDSPEAKER SYSTEM

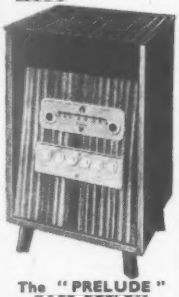
WITH W-B's WELL-KNOWN RANGE OF READY-TO-ASSEMBLE CABINETS. ALL ARE BEAUTIFULLY MADE AND FINISHED AND VERY EASILY ASSEMBLED. ONLY A SCREWDRIVER IS REQUIRED. THEY ARE PACKED FLAT IN CARTONS AND COMPLETE WITH SCREWS.
WE SHOW A FEW HERE BUT OTHERS ARE AVAILABLE. SEND S.A.E. FOR LEAFLET.

CALL IN AND LISTEN TO THEM.



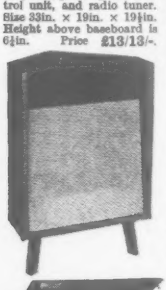
THE JUNIOR BASS REFLEX CORNER CONSOLE

A new contemporary-style cabinet, specially designed to give maximum reproduction quality from Stentorian 8in. or 10in. units with provision for Tweeter Unit, if required. Measures 33in. × 23½in. × 18½in. Price £9/9/- or with the 8in. Stentorian Speaker £13/12/6 or with 10in. Stentorian Speaker £14/8/6.



The "PRELUDE" Hi-Fi CONSOLE CABINET

Takes any make of tape-deck or record player amplifier, pre-amplifier control unit, and radio tuner. Size 33in. × 19in. × 19½in. Height above baseboard is 6½in. Price £13/13/-.



The "PRELUDE" BASS REFLEX CORNER CONSOLE

This most attractive cabinet has been specially designed to utilise the natural acoustic properties of the walls, and is also obviously suitable for use where space-saving is a consideration. It's sturdily constructed to take every advantage of Stentorian 8in. or 10in. units, with provision for Tweeter Unit. Size 33in. × 21in. × 17in. Price £10/10/- or with the 8in. Stentorian Speaker £14/13/6 or with the 10in. Stentorian £15/9/6.

The "PRELUDE" Hi-Fi TABLE CABINET

Designed to take any make of Tape Deck or Single Record Player (not Auto-changers) Amplifier Pre-amplifier Control Unit, and Radio Tuner. Price £9/19/6. Size 19½in. × 19in. × 19½in.

HIRE PURCHASE and CREDIT SALES TERMS ARE AVAILABLE . . . SEND S.A.E. for details.
WE ALSO HAVE THE GOODMANS SHERWOOD ENCLOSURE IN STOCK.

THE DULCI MODEL H3.

COMBINED AM/FM RADIOGRAM CHASSIS

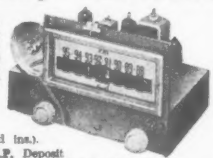
This model is very similar to the model H.4 described above but covers 3 WAVEBANDS instead of 4 (omitting the Short Band) and is for 3 ohm Speakers only. Overall size is as for the H.4.

PRICE **£20.17.0** (Plus 7/6 carr and ins.).

CREDIT TERMS: Deposit £5/4/3 and 9 monthly payments of £1/18/4. H.P. TERMS: Deposit £10/8/6 and 12 monthly payments of 19/4.

Stern's "fidelity" F.M. TUNING UNIT

A 5-Valve Tuner incorporating the latest Mullard Permeability Tuned Unit. Price assembled less Power Supply:



£14.10.0

(Plus 7/6 carr. and ins.).

TERMS: (a) H.P. Deposit £7/5/- and 9 monthly payments of 18/4.
(b) Credit Deposit £3/12/6 and 9 monthly payments of £1/6/7. Provides "Hi-Fi" reproduction with any make of Amplifier and many Radio Receivers. It incorporates: ● The latest Valve line-up—ECC85, 2 type EF86, EF91 and EM85. ● A "Magic Eye" Indicator. ● Power consumption is 1.7 amps. at 6.3 volts and 25 m/s. at 250 volts.

STERN'S "fidelity" COMBINED A.M. and F.M. TUNING UNIT

This is IDENTICAL to the Stern's F.M. Tuner illustrated above, but in addition incorporates the MEDIUM WAVEBAND and thereby also provides a selection of foreign stations. PRICE **£18.18.0** (Plus 7/6 carr. and ins.).

TERMS:—(a) H.P. Deposit £9/9/- and 10 monthly payments of £1/1/-; (b) Credit Deposit £4/15/- and 9 monthly payments of £1/14/7. Send S.A.E. if further data required.

HOME CONSTRUCTORS . . . You can build
(a) The "fidelity" F.M. TUNING UNIT FOR **£10.0.0**
(b) The "fidelity" AM/FM TUNING UNIT for **£13.10.0**

The COMPLETE ASSEMBLY DIAGRAMS and INSTRUCTIONS CAN BE OBTAINED FOR 1/6 each.

!! SPECIAL CASH OFFERS !!

The Latest Collaro 4 Speed Single Record Player

Incorporating the very popular STUDIO "0" CRYSTAL PICK-UP
For only **£6.19.6**
(Plus 5/- carr. and ins.).
Incorporates Auto-Stop and Plays 78 r.p.m. and all types of L.P. Records.

The Collaro "Junior" Rim Drive 4 Speed Record Player

Offered complete with Collaro Crystal Pick-up For £4/10/0. (Plus 4/- carr. and ins.) We also offer . . . Gram Motor and Turntable at £3/2/6. Crystal Pick-up only. £1/12/6. (Carr. and Ins. 2/6 extra)

"FRUSTRATED EXPORT ORDER"

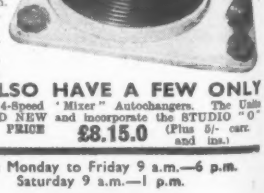
The Cossor Model 537/X4 Valve "Aldrey" Battery Portable.
Offered For **£6.15.0**
Plus 5/- carr. & ins

Consists of a 4 valve Superhet Receiver covering Medium Waveband 197-575 metres, and two Short Wavebands 13.6 to 136 metres. The new low consumption valves are incorporated and the whole is accommodated in an attractive robustly made case. Battery required is 90 volts and 1.4 volts (price 19/6) and is external to case.

RECORD PLAYERS
THE VERY LATEST MODELS ARE IN STOCK
MANY AT REDUCED PRICES !!!!
TRANSCRIPTION UNITS—AUTOCHANGERS SINGLE RECORD PLAYERS
Send S.A.E. for ILLUSTRATED STOCK LIST

CASH ONLY OFFER !!!

This latest Brand New B.S.R. MONARCH 4-SPEED AUTOCHANGER **£7.19.6** (Plus 5/- carr. and ins.).



● Minimum baseboard size required 14in. × 12½in. with height above 5½in. & height below baseboard 2½in.

WE ALSO HAVE A FEW ONLY
COLLARO 4-Speed 'Mixer" Autochangers. The Units are BRAND NEW and incorporate the STUDIO "0" Pick-up. PRICE **£8.15.0** (Plus 5/- carr. and ins.)

Open Monday to Friday 9 a.m.—6 p.m.
Saturday 9 a.m.—1 p.m.

STERN RADIO LTD.

THE 1958 NEW LOOK

MULLARD DESIGNS FOR THE HOME CONSTRUCTOR

AMPLIFIERS PRE-AMPLIFIERS

COMPLETE KITS OF PARTS FOR THE "HI-FI" ENTHUSIAST

Designed by MULLARD—Presented by US strictly to their specification.

THE VERY POPULAR MULLARD "5-10" MAIN AMPLIFIER

Undoubtedly the most successful amplifier yet designed, and used in conjunction with the new Mullard Pre-Amplifier, an undistorted power output of up to 10 watts is obtained. Thoroughly recommended to the "Hi-Fi" enthusiast who contemplates a very high quality home installation. In addition the versatility of the equipment makes it quite suitable for use in small halls, etc. We supply complete to MULLARD'S SPECIFICATION with specified valves and components and including the latest PARMEKO Ultra linear Output transformer. Has power available to drive Radio Tuning Unit.

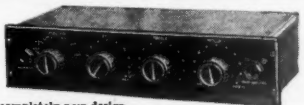
Price for COMPLETE KIT OF PARTS..... **£10.0.0**

Alternatively we supply ASSEMBLED and TESTED **£11.10.0**

(Carriage and insurance 5/- extra.)

We also offer this "5-10" incorporating the latest PARTRIDGE ULTRA-LINEAR OUTPUT TRANSFORMER for £1/6/-. extra.

MULLARD'S NEW 2-STAGE PRE-AMPLIFIER-TONE CONTROL UNIT



A completely new design employing two EF86 valves, and in particular designed to correctly operate with the Mullard range of Power Amplifiers.

Briefly it incorporates:—

- Equalisation for the latest B.I.A.A. characteristics.
- Input for variable reluctance. Magnetic Pick-ups.
- Input for Crystal Pick-ups.
- Input for Tape replay.
  - (a) Direct from High Impedance Tape Head.
  - (b) From a Tape Amplifier or Pre-Amplifier.
- Sensitive Microphone Channel.
- Wide range BASS and TREBLE Controls.
- Attractive Perspex front control panel.
- Our Kit is strictly to MULLARD'S SPECIFICATION.

Price, COMPLETE KIT OF PARTS **£6.6.0**

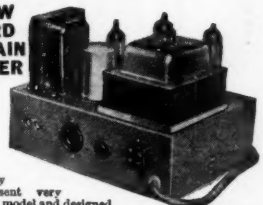
Alternatively we supply ASSEMBLED and TESTED..... **£8.0.0**

(Carriage and Insurance 5/- extra.)

NOTE WE DO *NOT* USE SURPLUS OR CHEAP COMPONENTS IN ANY OF OUR MULLARD KITS or ASSEMBLED UNITS.

Please enclose S.A.E. if ILLUSTRATED and DESCRIPTIVE LEAFLETS are required ... alternatively the COMPLETE ASSEMBLY MANUALS containing component Price Lists and practical Drawings etc. are available at 1/6 each.

THE NEW MULLARD "3-3" MAIN AMPLIFIER



Based entirely on the present very popular "3-3" model and designed to operate in conjunction with the new 2-stage PRE-AMPLIFIER (shown here) this providing all the facilities associated with the more expensive "Hi-Fi" equipment. We recommend this the IDEAL SMALL HOME INSTALLATION where very high quality is desired at the lower volume level (up to 3 watts).

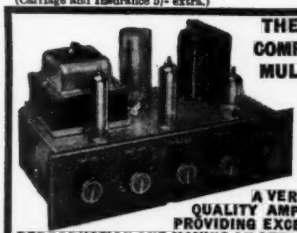
We supply completely to MULLARD'S SPECIFICATION INCLUDING the latest PARMEKO Output Transformer, specified Valves and Components. Has Power available to drive a Radio Tuning Unit.

Price for COMPLETE KIT of PARTS **£7.0.0**

Alternatively we supply ASSEMBLED and TESTED..... **£8.0.0**

(Carriage and Insurance 5/- extra.)

THE NEW COMPLETE MULLARD "3-3"



A VERY HIGH QUALITY AMPLIFIER PROVIDING EXCELLENT REPRODUCTION AND HAVING AN ATTRACTIVE ENGRAVED PERSPEX FRONT PANEL.

Price for COMPLETE KIT OF PARTS **£7.10.0**

(plus 6/6 carriage and insurance).

Alternatively supplied ASSEMBLED and FULLY TESTED **£8.19.6**

(plus 6/6 carriage and insurance.)

The complete specification is available for 1/6.

Developed from the very popular 3-valve 3-watt Amplifier designed in the Mullard Laboratories. Our kit is complete to the Mullard specification, including supply of specified components, valves and a PARMEKO OUTPUT TRANSFORMER. We also include switched inputs for 78 and L.P. records plus a Radio position. Extra power to drive a Radio Tuning Unit is also available.

SPECIAL PRICE REDUCTIONS—WE OFFER

(a) THE COMPLETE KIT of PARTS to build both the "3-3" MAIN AMPLIFIER and the 2-stage PRE-AMPLIFIER-CONTROL UNIT **£12.10.0**

(b) THE COMPLETE KIT of PARTS to build both the "5-10" MAIN AMPLIFIER and the 2-STAGE PRE-AMPLIFIER-CONTROL UNIT **£15.15.0**

*ALL PRICES QUOTED FOR THE "5-10" ARE SUBJECT TO £1/6/- EXTRA IF THE PARTRIDGE TRANSF. IS REQUIRED.

HIGH QUALITY OF THIS NATURE HAS NEVER BEFORE BEEN OFFERED AT SUCH LOW COST

(a) THE "3-3" and the 2-STAGE PRE-AMPLIFIER both ASSEMBLED and TESTED..... **£15.0.0**

CREDIT TERMS: DEPOSIT £3/15/- and 9 monthly payments of £1/7/6.

H.P. TERMS: DEP. £7/10/- & 9 monthly payments of 19/-.

(b) THE "5-10" and the 2-STAGE PRE-AMPLIFIER both ASSEMBLED and TESTED..... **£18.18.0**

CREDIT TERMS: DEPOSIT £4/15/- and 9 monthly payments of £1/14/7.

H.P. TERMS: DEP. £9/9/- & 12 monthly payments of 17/6.

When ordering please include an extra 7/6 to cover cost of carriage and insurance.

THE NEW COMPLETE MULLARD "5-10" AMPLIFIER

ANOTHER NEW DESIGN ILLUSTRATION NOT AVAILABLE AT TIME OF GOING TO PRESS AMPLIFIERS AVAILABLE EARLY APRIL

This Amplifier is similar to the "5-10" illustrated above, but it has ALL CONTROLS incorporated on the Amplifier Chassis in the same way as the "3-3" (illustrated alongside) finished with our attractive PERSPEX FRONT PANEL, thus forming a complete Amplifier.

We supply it complete to the MULLARD SPECIFICATION including specified Valves and components and incorporating the latest PARMEKO ULTRA LINEAR OUTPUT TRANSFORMER and switched inputs for 78 and L.P. Records plus a Radio Tuning Unit. Extra Power is available to drive the Tuning Unit.

Separate BASS and TREBLE CONTROLS provide excellent range of tone and we recommend the Amplifier to those with limited Cabinet space who require GENUINE HIGH QUALITY at a higher volume level than the "3-3" but without the versatility of the separate Preamplifier-Control Unit with Main Amplifier.

Price COMPLETE KIT of PARTS **£11.0.0**

Alternatively we supply ASSEMBLED and TESTED **£13.10.0**

Credit Sale: Dep. £3/7/6 & 9 monthly payments of £1/4/11.

H.P. Terms: Dep. £6/15/- & 8 monthly payments of 19/3.

Send S.A.E. for ILLUSTRATED LEAFLET or alternatively the COMPLETE ASSEMBLY MANUAL IS AVAILABLE FOR 1/6.

STERN'S "fidelity" PRE-AMPLIFIER-TONE CONTROL UNIT

A versatile 2-State Unit using two ECC 83 Valves and incorporating a Preset Output Control, the function of this Control is to provide for variation of output, thus enabling the Unit to be used with any Amplifier where correct matchings and a good tone range is desired.

Briefly it incorporates: (a) Inputs for all types of MICROPHONES, HIGH or LOW GAIN PICK UPS and RADIO TUNING UNIT (b) STEEP CUT FILTER (c) GRAM EQUALISER (d) Separate BASS and TREBLE CONTROLS (e) Input for TAPE REPLAY (f) Attractive PERSPEX FRONT CONTROL PANEL. The outstanding features of this unit are: correct equalising for Gram reproduction, excellent control of Bass and Treble, extreme simplicity of operation.

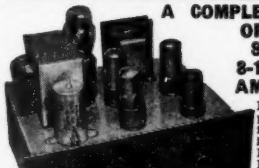
Price COMPLETE KIT OF PARTS **£6.16.0**

Alternatively we supply ASSEMBLED and TESTED **£8.10.0**

(Carriage and Insurance 5/- extra.)

The ASSEMBLY MANUAL, containing Specification and Drawings, etc., is available for 1/6 or send S.A.E. for illustrated leaflet if required.

A COMPLETE KIT OF PARTS, STERN'S 8-10 WATT AMPLIFIER



Has power supply available for Radio Tuning Unit.

Price of COMPLETE KIT OF PARTS (plus 5/- carr. & ins.) **£7.10.0**

WE ALSO OFFER IT ASSEMBLED and READY FOR USE for (plus 5/- carr. & ins.) **£9.10.0**

This amplifier has proved one of the most popular models yet offered to the HOME CONSTRUCTOR. It provides really excellent reproduction up to 8 watts, employing 6V6's in push-pull and incorporating negative feedback. Provides for the use of both 3 and 15 ohm Speakers. The complete SPECIFICATIONS and BUILDING INSTRUCTIONS ARE AVAILABLE for 1/6.

SPECIAL CASH ONLY OFFER ! !

This very attractive PORTABLE AMPLIFIER CASE together with a good quality GRAM AMPLIFIER and a matched P.M. SPEAKER. ALL FOR ONLY **£8.7.6**

(plus 7/6 carr. & ins.). The Amplifier consists of a 2 Stage design incorporating the 3 modern BVA valves and has separate BASS and TREBLE CONTROLS. The Portable Case will also accommodate almost any make of Autochanger and is attractively finished in Grey colour Rexine—WE ALSO SUPPLY SEPARATELY:—

(a) The 2-Stage (plus Rectifier) AMPLIFIER **£4/2/6**

"HI-FI" AMPLIFIERS IN STOCK

include STERNS COMPACT "5-2". DULCI D.P.A.10 DULCI H.11. ARMSTRONG A10 Mk11. "Variolope" LEAK "VARIELOPE" PRE-AMPLIFIER. ROGERS "JUNIOR" E.C.A. ORTHOPHONIC. *Send S.A.E. for details.*

F.M. TUNING UNITS BY MOST OF THE LEADING MANUFACTURERS.

(b) The PORTABLE CARRYING CASE..... £3/17/6

(c) 8in. P.M. SPEAKER 18/9

(Carriage and insurance 4/- extra.)

We also have a smaller PORTABLE CASE ideal for Record Players. PRICE ONLY £3/3/- (plus 3/- carr. & ins.). Attractively finished in high-grade Rexine and robustly constructed with internal measurements at 13½ x 15½in. high. It will therefore accommodate all makes of Record Players including Autochangers. An uncut baseboard is also supplied.

STERN'S POWER SUPPLY UNIT

Fully smoothed with all output connections terminated to connecting Blocks. Overall size is 9½in. x 3½in. x 4½in. high. TWO MODELS AVAILABLE, Type "A" provides 250-300 volts up to 70 m/a. and 6.3 volts at 3½ amps. PRICE **£2.17.6**

Type "B" Unit 250-300 volts at up to 100 m/a. and 6.3 volts at 3½ amps. PRICE **£3.3.0.**

(Plus 2/- carr. and ins.).

Please enclose S.A.E. with all enquiries

109-115 FLEET ST. LONDON E.C.4

Phone: FLEet Street 5812-3-4

LASKY'S RADIO

SAVE POUNDS! ORDER BY POST IF YOU CANNOT CALL

Special Offer! PORTABLE TAPE RECORDER AMPLIFIERS

Mains 200/250 v. A.C. 6 watts output. For use with low impedance Tape Heads. 4 valves: EZ41 rect., EL41 output, EF40 and ECC31. Tone, volume and record/play back controls. Neon level indicator. Microphone and gram inputs. Can be used as a straight amplifier. Circuit diagram supplied.
LASKY'S PRICE **£6.19.6**
Complete with valves. Post & Pkg. 5/-.
Full details on request.

TRANSISTORS

Hermetically sealed and unaffected by temperature variations. Tested and guaranteed efficient.

R.F. P.N.P. Junction Type, suitable for medium and low freq. oscillators freq. changers and I.F. amplifiers (1.5 to 8 Mc/s). **21/-**

(Double spot—yellow and red.)

AUDIO P.N.P. Junction Type, suitable for high gain and low freq. amplifiers, and for out..ut stages up to 250 milliwatts. **10/-**

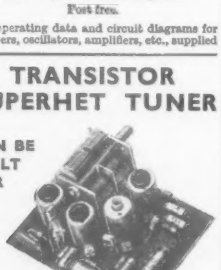
(Double spot—yellow and green).

Post free.

Full operating data and circuit diagrams for receivers, oscillators, amplifiers, etc., supplied

TRANSISTOR SUPERHET TUNER

CAN BE BUILT FOR



£5.12.9
Post 3/6.

For construction on Printed Circuit. Size 3¾ × 3¼in. Uses 3 R.F transistors, 1 germanium diode, 3 I. F. transformers, Ferrite rod aerial. Operates from 6v. battery and 1.5 v. cell.

Full details on request.

Demonstrations at both addresses.

TRANSISTOR AMPLIFIER KIT

200 milliwatts. Output impedance 5 ohms. Operates from 6 v. battery. Miniature size: 3¼in. × 3¼in., height can be under 1in. COMPLETE KIT including 4 Transistors, PRINTED CIRCUIT, full instructions. Post 2/6. Full details on request. **79/6**

LASKY'S FULLY TRANSISTORISED PORTABLE FOR HOME CONSTRUCTION

Note these Star features.

- ★ Printed Circuit. 6¼in. × 2¼in.
- ★ 200 milliwatts p.p. output.
- ★ Uses 7 Transistors and 1 germanium diode.
- ★ Ferrite rod aerial.
- ★ Fully tunable.
- ★ Uses one 6 v. and one 1½ v. battery. Very low consumption.
- ★ Choice of 7 × 4 elliptical or 3½in. P.M. Speaker.
- ★ Choice of cabinet.
- ★ Most important—a keen price! Send for full details.

COLLARO TAPE DECK MOTORS, set of 3, clockwise, anti-clock capstan. List £5/15/-.
LASKY'S PRICE **95/-**
Post 5/-.

MULLARD TRANSISTORS

OC70	OC71	OC72	OC16
21/-	21/-	30/-	60/-

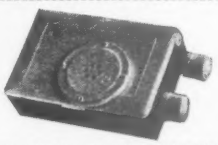
BRIMAR TRANSISTORS

TS1 12/6. TS2 12/6. TS3 15/-.
TS4 27/6. TP1 or TP2 40/-.
TJ1 15/-. TJ2 16/6. TJ3 19/6.

LONDON'S HI-FI SPECIALISTS!

Visit our Tottenham Court Road address for selective Demonstrations of the latest HI-FI Equipment as shown at the recent LONDON AUDIO FAIR.

AMPLIFIERS. QUAD, ROGERS, LEAK, RCA., PAMPHONIC, DULCI, W/B, and the new ARMSTRONG A10 Mk. II.
SPEAKERS. WHARFEDALE, GOODMANS, LOWTHER, G.E.C., LORENZ, PHILIPS, ETC.
PICK-UPS. COLLARO, GARRARD, CONNOISSEUR, LEAK, B/J, ORTOPHONE, GOLDRING.
TRANSCRIPTION TURNTABLES. COLLARO, GARRARD, LENCO, CONNOISSEUR ETC.
TAPE RECORDERS. GRUNDIG, ELIZABETHAN, BRENELL, TRUVOX, SOUND, VORTEXION, FERROGRAPH, MAGNAVOX, and the new HARTING
CABINETS. WIDE SELECTION INCLUDING THE NEW G-PLAN CONTEMPORARY CABINETS.



TELETRON "COMPANION"
3-TRANSISTOR POCKET RADIO. T.R.F. circuit covering med. and long waves, with balanced armature output. Ferrite aerial. Size: 4¼ × 3 × 1in.
CAN BE BUILT FOR ONLY **89/6**
Full instructions and price list. 6d. post free.

TAPE DECKS

COLLARO TAPE PRE-AMPLIFIER, fitted and wired. **£21.**
LANE DECK Mk. VI **£18/10/-.**
WEARITE DECKS **£35** & **£40.**
Carr. extra.

All leading makes in stock. Latest COLLARO "TAPE TRANSCRIPTOR," Mk. III, fitted with digital counter, **£22.** Carr. paid.

LASKY'S 4-WATT PORTABLE GRAM. AMPLIFIER

Will suit any crystal or magnetic pick-up. Uses 3 valves: EL84 output, L63 and EZ80 rect.
COMPLETE with 3 valves and knobs, less Speaker **79/6**
Carr. 5/-.
7in. × 4in. Ellip. Speaker, if required, 19/6 extra
Details and circuit diagram post free.

LASKY'S PORTABLE GRAM. AMPLIFIER KIT

2 watts. Size approx. 6¼in. × 3¼in., max. height 5in. Uses EL84 output and 6X4 rectifier, double-wound transformer, tone control, output transformer, etc.
COMPLETE KIT, including valves, printed circuit, full instructions, less Speaker **49/6**
Carr. 2/6.
7in. × 4in. Elliptics. Speaker, if required, 19/6 extra.

SPECIAL OFFER OF MAGNETIC RECORDING TAPE

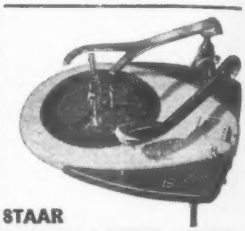
FAMOUS MAKE. P.V.C. base on latest type plastic spools. Not surplus but brand new, perfect and boxed. Will work with any Recorder. Limited quantity only. Send now! Satisfaction or money refunded.

1,200ft. Standard on 7in. spool, List 35s. Lasky's Price	21/-
850ft. Standard on 5¾in. Continental spool, List 28s. Lasky's Price	16/6
600ft. Standard on 5in. spool, List 21s. Lasky's Price	12/6
1,200ft. Long Play on 5¾in. Continental spool, List 35s. Lasky's Price	22/6
859ft. Long Play on 5in. spool, List 28s. Lasky's Price	16/6

Post. 1 spool 1s. 6d. Orders over 70/- post free.

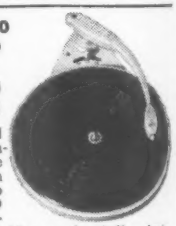
COLLARO 4-SPEED MIXER AUTO-CHANGERS

Incorporating auto and manual control. Complete with Studio crystal p.u. and sapphire stylus. RC.456. List £13/17/-.
LASKY'S PRICE **£7.19.6**
Post 3/6.
Latest model RC.457 (Continental). **£8/19/6**
Post 3/6.



STAAR GALAXY 4-SPEED MIXER AUTO-CHANGER

Brand new and unused in makers' original cartons. Modern design, smart duo-tone finish, complete with crystal pick-up with styli. Incorporates auto and manual control with fingertip stop, start and speed change. For A.C. 200-250 v.
Listed at £12. LASKY'S PRICE **79/6**
Post & Pkg. 5/-.



COLLARO 4-SPEED SINGLE RECORD PLAYER

Model 4/564 complete with Studio T or O p.u. crystal cartridge and styli. Automatic stop.
LASKY'S PRICE **£6.19.6**

Collaro "Junior" 4-sped motor and pick-up with HGP59 cartridge. 92/6
Post free.
Motor only, 59/6, post 2/6.
Pick-up only 29/6, post 2/6.

B.S.R. TU9, 4-spd. motor and latest B.S.R. "ful-fi" p.u. 94/-.
Post 3/6.

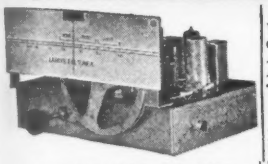
Delivery from stock of the **COLLARO 4-speed Transcription Turntable**
4T200/PX **£19/10/-.**
Less pick-up **£14/18/0.** Carr. Paid.

PICK-UP CARTRIDGES
GARRARD MAGNETIC t/o, p.u. Cartridges. Type TOM/2, less than half-price, 30/-, post 1/-.
ACOS turnover, complete with Lp. and standard styli. LIST £2/1/7
LASKY'S PRICE **18/-**
Post 1/-.

BAND III CONVERTERS
ALL TYPES IN STOCK, **99/6**
Prices from
P.P. 5/-

RADIO · TELEVISION · HI-FI · ELECTRONICS · RECORDERS

LASKY'S RADIO



LASKY'S F.M. TUNER

PRINTED CIRCUIT VERSION OF G.E.C. 912 "F.M. PLUS" TUNER FOR HOME CONSTRUCTION

Uses 5 valves, 2 germanium diodes and brand new T.C.C. condensers. The PRINTED CIRCUIT ensures that the I.F. and R.F. amplifiers are extremely stable at maximum gain and results are consistent on all tuners.

CAN BE BUILT FOR (including valves) Post and Pkg. 2/6. **£7.19.6**

G.E.C. FM TUNER BOOK plus our full data and Shopping List, 2/6 post free. All parts available separately. ALIGNMENT SERVICE available.

JASON F.M. TUNER

Special Parcel containing data book, chassis front panel, dial, drive, tuning condenser, full sets of coils, I.F.s, ratio detector etc. Post 2/6 **68/9**

DATA BOOK with price list 2/-. This tuner can be built for £6/15/-, post 3/6.

JASON "ARGONAUT"

Super-sensitive AM/FM Tuner. Complete parcel with power supplies. Post 3/6. **£13.19.6**

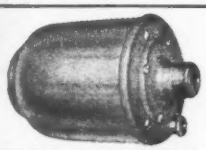
DATA BOOK 2/- post free.
Chassis Assembly 57/9, post 2/6
I.F. and Coil Set 78/-, post 1/6.
All components available separately.

OTHER F.M. TUNERS

TSL £17/10/-. DULCI £17/10/-. DULCI M4T 4-wave AM/FM, £20/17/-. Also Quad, Leak, RCA, Rogers, Pamphonic, etc.

MOVING COIL P.M. SPEAKERS

3in. 17/6. 3in. and 3½in. 19/6. 5in. 16/6. 6½in. 17/6. 8in. 21/-. 10in. 29/6. 12in. 29/6. 6½in. with transformer 21/-. 7 × 4in. 19/6. 10 × 7in. Elliptical 32/6.



TRUVOX 'SENIOR' SPEAKER DRIVING UNIT (Pressure Type)

Power handling cap. 15 watts peak. With 12ft. cinema horn reproduces down to 17 c.p.s. List £7/15/-. LASKY'S PRICE 59/6. Carr. 6/-.

15in. DUAL CONCENTRIC SPEAKERS

Famous make, high fidelity, 25 watts, 15 ohms imp. List £27/4/6.
LASKY'S PRICE **£16.19.6**
Full details on request.

HI-FI ELECTROSTATIC SPEAKERS ('TWEETERS')

LSH75	LSH518	LSH100
8/-	12/6	14/-

LPH65 (moving coil) 39/6.

CHASSIS

We have the largest stocks of chassis A.M. and A.M./F.M. A.M. chassis, 1, m, s, from 7 Gns. AM/FM chassis ..... from 14 Gns.

DULCI HI-FI CHASSIS TUNERS and AMPLIFIERS

New designs including:—

Mdl. H.3. AM/FM Radiogram Chassis, 3 wave bands including V.H.F. **£20/17/-**

Mdl. H.4. AM/FM Radiogram Chassis, 4 wavebands, including V.H.F. **£24/6/6**

Mdl. H.4.PP. AM/FM Radiogram chassis, 4 waves including V.H.F. 6-8 watts o.p. push-pull, ultra linear **£29/3/10**

Mdl. H.11. Combined and self-powered AM/FM Tuner, Control Unit and Audio pre-amplifier. **£29/3/10**

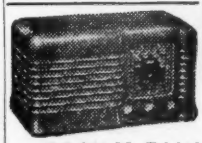
Mdl. DPA.10. 10-14 watt Ultra Linear Power Amplifier **£12/12/-**

Mdl DP.4. 4-watt High Fidelity Amplifier **£7/10/-**

New AVO MULTIMINOR. 19 ranges A.C. and D.C. 10,000 ohms per volt. D.C. 1,000 ohms per volt A.C. Pocket size: 5½ × 3½ × 1¼in. Complete £9/10/-. Post 3/6.

POCKET VOLT TEST METERS Two ranges D.C. 0-250 v and 0-25 v. Complete with leads in leather case.
LASKY'S PRICE **12/6**
Post free.

H.P. TERMS AND CREDIT SALES AVAILABLE



EASILY BUILT RADIO SETS

Size 12 × 6½ × 5½in. deep. Choice of walnut veneer wood cabinet or walnut or ivory plastic cabinet.

PARCEL No. 1

Everything to build a 4-valve 3-wave superhet for 200/250 A.C mains. Uses 6K8, 6K7, 6Q7, 6V6 valves.
CAN BE BUILT FOR Carr. and packing 2/6. **£7.19.6**

PARCEL No. 2

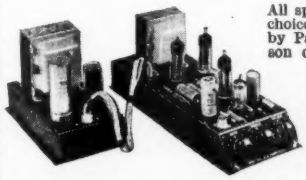
Everything to build a T.R.F. 3-valve set for 200/250 A.C. mains, medium and long waves. Uses 6K7G, 6J7, 6V6 and metal rectifiers.
CAN BE BUILT FOR Carr. and packing 2/6. **£5.10.0**

INSTRUCTION BOOK for either above sets 1/- post free.

CABINETS ONLY, 17/6. Post 2/6.

All components available separately.

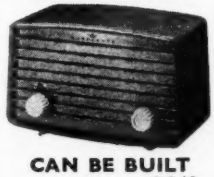
MULLARD 510 AMPLIFIER KIT WITH T.C.C. PRINTED CIRCUIT



All specified components and your choice of transformers and chokes by Partridge, Haddon, W/B, Ellison or Gilson.

COMPLETE KIT of parts and printed circuit as low as **£9.9.0** Details on request. Book 3/6 post free. Printed Circuit separately 22/6. Also available built ready for use. Price according to transformers used.

LASKY'S NEW MIDGET T.R.F.

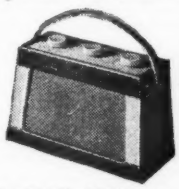


CAN BE BUILT FOR ONLY 99/6

Post & Pkg. 5/-.

Handsome contemporary design case, overall size 8½in. wide, 4½in. deep, 5in. high. 2 latest double-purpose valves EBF89 and ECL80, contact cooled rectifier. For A.C. mains 200-250 v. Med. and long wave, 5in. P.M. speaker. Plastic cabinet in cream, pastel green, pink, blue. FULL DATA, instructions, circuit diagram, shopping list 1/6. All components available separately. CABINET only, as illus., 14/- plus 4/6 post and pkg.

BUILD THIS 4-VALVE S/HET PORTABLE



FOR ONLY £7/7/- plus 3/6 carr. and pkg., you can build this med. and long wave Portable using all brand new components and valves, only batteries extra. Printed circuit, circuit diagram and full instructions supplied. Circuit diagram and full data 1/6 post free.

FOR ONLY £9/9/- plus 3/6 carr. and pkg. you can build this job as a mains and battery Portable using our specially designed build-it-yourself Power Unit for 200-250 v. A.C.

MINIATURE MOTORS

Complete with gearbox. Overall size. 2½in. long × 1¼in. × 1in. Works with any voltage from 6 to 12. Ideal for models, remote control etc. Original cost over £2.
LASKY'S PRICE **12/6**
Post 1/6.

20,000 VALVES IN STOCK

Brand new surplus and imported valves also full stocks of B.V.A. valves and C.R. Tubes. List post free.

RECTIFIERS

RM.0, 125 v. 30 m/a.	4/11
RM.1, 125 v. 60 m/a.	5/11
RM.2, 125 v. 100 m/a.	6/6
RM.3, 125 v. 120 m/a.	7/6
RM.4, 250 v. 250 m/a.	16/-
RM.L, 250 v. 300 m/a.	21/-

Post extra.
All makes and types in stock.

MAINS TRANSFORMERS

All 200-250 v. 50 c.p.s. primary, finest quality, fully guaranteed.

MBA/3. 350-0-350 v. 80 mA. 6.3 v. 4 a. 5 v. 2 a. Both filaments tapped at 4 volts. **19/6.**

MBA/7. 250-0-250 v. 80 mA. 6.3 v. 3 a., 5 v. 2 a. Both filaments tapped at 4 volts. **19/6**

AT/3. Auto trans. 0-10-120, 200-230-240 v. 100 watts **19/6**

M.T.341. Tapped input 250-0-250. 120 mA 6.3 v. 5 amps. fully shrouded **27/6**

FILAMENT TRANSFORMERS

All 200-250 v. 50 c.p.s. primary, finest quality fully guaranteed.
6.3 v. 1.5 amp. **5/11.** 6.3 v. 3 amp. **9/6.** 0-30 v. 2 amp. tapped voltages, **19/6.**

GERMANIUM CRYSTAL DIODES

GEX.00 **1/6.** GEX.34 **3/6.** WG5 **3/6.** GEX 54 and OA74 **5/-**, GD3 **3/6.** GD4 **3/6.** CG12E **5/-.**

MAKERS' SURPLUS T.V. COMPONENTS

WIDE ANGLE 23 mm.

Line E.H.T. trans., ferrox-cube core, 9-16kV.	25/-
Scanning Coils, low imp. line and frame	25/-
Ferrox-cube cored Scanning Coils and Line Output Trans., 10-15 kV., EY51 winding. Line Trans. Complete with circuit diagram, the pair	50/-
Frame Output Transformer	6/6
Scanning Coils, low imp. line and frame	17/6
Frame or line blocking osc. transformer	4/6
Focus Magnets Ferrox-dure	19/6
P.M. Focus Magnets. Iron Cored ..	19/6
Duomag Focalisers	22/6
300 m/a. Smoothing Chokes	15/-

STANDARD 36 mm.

Line Output Transformers 6.9 kV. E.H.T. and 6.3 v. winding. Ferrox-cube	19/6
Scanning coils. Low imp. line and frame	12/6
Ditto by Igranic	14/6
Frame or line blocking oscillator transformer	4/6
Frame output transformer	7/6
Focus Magnets	
Without Vernier	12/6
With Vernier	17/6
200 m/a. Smoothing Chokes	10/6

LASKY'S (HARROW ROAD) LTD.

LASKY'S RADIO

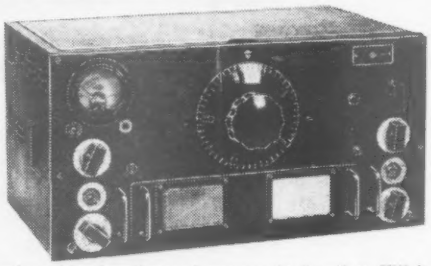
42 TOTTENHAM COURT ROAD, W.1.
Nearest Station Goodge Street
MUSeum 2605.

370 HARROW ROAD, PADDINGTON, W.9.
(Opposite Paddington Hospital)
LAD 4075 and CUN 1979.

Open all day Saturday. Early closing Thursday (both addresses)

ALL MAIL ORDERS TO HARROW ROAD PLEASE

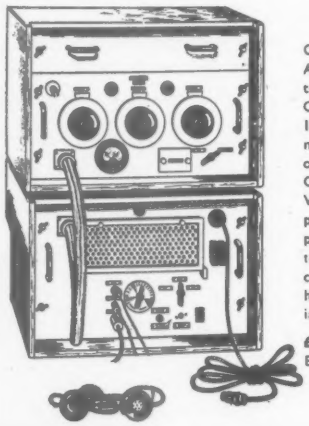
HRO SENIOR MODELS.



Complete with valves, 9 general coverage plug-in coilsets 50 Kc/s. to 30 Mc/s., instruction booklet, and circuit, but less external power supply unit.
Table models, as new condition, **21 GNS.** Rack Mounting, **18 GNS.** Packing and carriage 22/– extra.

Send S.A.E. for further details.

TRANSMITTER TYPE 36.



Complete 110-250 v. A.C. mains operated transmitter for speech, CW or MCW. Covers 10-60 Mc/s. (10-15-20 metre Ham Bands) but only 10-40 coils supplied. Crystal or stabilised VFO. Push-pull 807's plate and screen modulate parallel 807's. Supplied tested, ready to use, with connectors, 16 valves, handset, operating instructions and circuit.

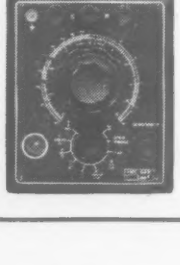
£12 10 0. Carriage England and Wales 30/–.

RCA TE-149 HETERODYNE WAVEMETERS.

Employs V-cut 1 Mc/s. Crystal (0.005%). Overall accuracy better than 0.02%. The dial is DIRECTLY calibrated every 1 Kc/s. between 2.5 and 5 Mc/s., and harmonics may be used up to 20 Mc/s. Provision for fitting internal dry batteries. Supplied as new in special transit case.

£9 19 6, Carriage 5/6.

MULLARD C & R BRIDGE

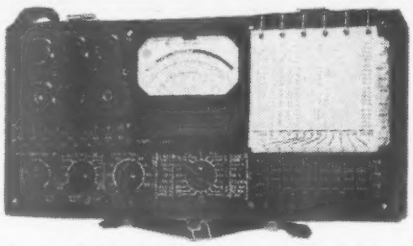


Resistance	Capacity
1/10th to 10 ohms.	10 to 1000 pFd.
10 to 1000 ohms.	0.001 to 0.1 mFd.
1 K to 100 K ohms.	0.1 to 10 mFd.
100 K to 10 Megohms.	

Minus 20% to plus 25% comparison scale. Provision for "Open Bridge." "Calibrate" position. Large easily read scale. Sensitivity control. Operates from 100-250 v. A.C. mains. In very good condition. Carefully tested and checked before despatch.

£7 10 0, P. & P. 3/6.

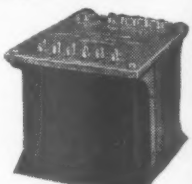
TRIPLETT COMBINATION TESTERS.



Brand new, ex-U.S.A. For valve, circuit, capacity, and other testing purposes. In neat black crackled metal case with lid and carrying handle. 15×7½×5½in. 4in. 100 micro-Amp. meter. Ranges: 0 to 10, 50, 250, 500 and 1,000 v. A.C. and D.C.; 0 to 500, 150 K, 1.5 Meg., and 15 Megohms; 0 to 1, 10, 50 and 250 milliamps, D.C. Valve tester has provision for "short" tests and inter-electrode voltages and currents. Complete with instructions, valve charts and batteries, ready for use on A.C. mains.

£14 19 6, Carr. 7/6.

PARMEKO H.T. TRANSFORMER.



Primary 230 v. 50 c/s. Secondary 620-550-375-0-375-550-620 v. (620 v. at 200 mA., 550 v. at 250 mA.). Two rectifier windings at 5 v. 3 amps. each. Total rating 278 vA. Upright mtg., weight 24lb. BRAND NEW. ORIGINAL BOXES.

45/–, Pkg. & Carr. 5/–.

SANGAMO-WESTON VOLTMETERS, Model S61.

A dual range 0-5 and 0-100 DC Voltmeter. Basic sensitivity 1,000 Ohms per volt. 3in. clearly calibrated scale. Knife-edge pointer. Easily modified for additional ranges and ideal for schools. Of recent manufacture, and supplied in high quality canvas carrying case, complete with test leads. Brand new and boxed.

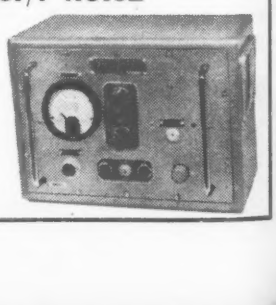
27/6d. P. & P. 2/6.

FERRANTI VOLTMETERS Model N5.

Flush mounting, moving iron, 6in. scale, 0-300 volts, 25-100 c/s. Latest type hermetically sealed, grade 1N. Date of manufacture 1955. Brand new and boxed.

79/6d. P. & P. 3/6.

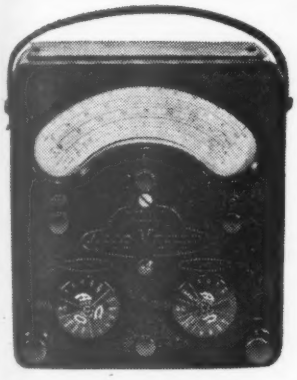
MARCONI TF 987/1 NOISE GENERATORS.



Range 100 Kc/s. to 200 Mc/s. Determines noise factor of AM AND FM receivers. Fully stabilised HT supply. AC mains operation. Brand new and in original boxes.

£25 0 0.

Best Buy at Britain's



AVOMETER Model D. £8-19-6 (P. & P. 4/-)

D.C. Volts	A.C. Volts	D.C. Current	A.C. Current
150 mV.	7.5 V.	15 m/A.	75 m/A.
300 mV.	15 V.	30 m/A.	150 m/A.
1.5 V.	75 V.	150 m/A.	750 m/A.
3 V.	150 V.	300 m/s.	1.5 Amps.
15 V.	300 V.	1.5 Amps.	7.5 Amps.
30 V.	600 V.	3 Amps.	15 Amps.
150 V.	750 V.	15 Amps.	
300 V.	1.5 KV.	30 Amps.	Resistance
750 V.			0-1,000 ohms.
1.5 KV.			0-10 K ohms.

Thoroughly overhauled. Complete with batteries and instructions. An extremely robust meter at a very reasonable price.

SANGAMO WESTERN Model E772 ANALYSER 10 Gns. (P. & P. 4/-)

A.C. and D.C. Volts	D.C. Current	A.C. Current
2.5 V.	100 micro-Amps.	0.5 Amp.
10 V.	1 milli-Amp.	1 Amp.
50 V.	10 milli-Amps.	5 Amps.
250 V.	50 milli-Amps.	
1,000 V.	100 milli-Amps.	Resistance
	500 milli-Amps.	0-100 ohms.
		0-1,000 ohms.
Output meter		0-100 K ohms.
		0-10 Megohms.

Supplied in neat black Rexine covered carrying case, complete with all batteries and instructions. Thoroughly overhauled and in perfect working order.

R1155 RECEIVERS. Model "B" with latest type SM drive. In good condition and perfect working order. Realigned and air-tested. S.A.E. for details of power packs, etc. **£7/19/6.** Carr. 10/6.

TECHRAD AMPLIFIERS (U.S.A.). High sensitivity, suitable for crystal, moving coil, or ribbon microphones/pickups, etc. Output 12 watts into 600-15-7.5-5.2.5 ohms. Complete with four 6J7 met., two 6L6GA, one 5U4G, and ready for use on 200-250 V. A.C. mains. In grey crackled steel case, 17 x 10 x 10in. Absolutely BRAND NEW. £13/10/-. Carr. 10/-.

BENDIX MODULATOR/POWER UNITS, Type MP-28-BA, for TA-12 transmitters. With 24 V. D.C. input, 540 V. D.C. 450 m/a. output dynamotor, 6N7met Mic. Amp., 6F6met Driver, and two 807 P.P. Modulators. Complete with Mic. Transf. and Mod. Transf for modulating two parallel 807's. Brand new **79/6.** Slightly soiled **69/6.** Carr. 7/6.

DYNAMOTORS. As used in the above. Brand new **32/6.** Used **19/6.** Wt. 13lb. Carr. 4/-.

MARCONI TF.340 OUTPUT METERS. Perfect working order. **£29/10/-.**

TRIPLETT MULTIMETERS
25 Ranges: 0 to 5, 25, 100, 250, 1,000, and 5 kV D.C. (20,000 OPV); 0 to 5, 25, 100, 250, and 1,000 v. A.C. (1,000 OPV); 0 to 50 microA, 1, 10, 100 and 500 mA 1 and 5 amps. D.C.: 0 to ½, 1, 5 and 10 amps. A.C.; 0 to 1,000, 100 K, and 10 megohms. Square meter, size 4 x 4in. Contained in 11¼ x 8 x 5¼in. wooden case, weight 10lb. Supplied complete with instruction book, batteries, leads and special high voltage leads. **BRAND NEW** ready for use and fully guaranteed. 15 gns. Post 5/-.

VIBRATOR PACKS. Input 6 v. D.C. Output approx. 100 v. D.3. at 30 m/amps., fully smoothed and R.F. filtered. Size 6½ x 5 x 2in. Fitted with Mallory 629C vibrator. **BRAND NEW.** Boxed. **12/6.**
ANOTHER, but 200 v. D.C. 100 m/amps. With OZ4 valve and vibrator. **BRAND NEW.** Boxed. **25/-.**

RCA OUTPUT TRANSFORMERS. As used in MI-11220 Amplifier. Primary for push-pull 6L6's. Secondaries 5, 7.5, 15, and 600 ohms, and tertiary for NFB. 25 watts power rating. Potted construction, with tag connections. Full circuit of RCA amplifier supplied. **BRAND NEW, 27/6.** Post 2/-.

AR77 MAINS TRANSFORMERS. Fully shrouded, drop-through 3½in. x 3½in. Primary 110/125/150/210/240 v. 50-60 c/s. Secs., 325-0-325 v. 100 m/amp., 6.3 v., 3.5 amp., and 5 v. 2 amp. BRAND NEW ex-U.S.A., **29/6.**

MINIATURE STC RELAYS. 250 ohms coil. DP C/O (double silver contacts). 1½ x ¾ x ½in. Wt. one oz. 6 v. operation. **7/6.**

METER BARGAINS

RANGE	TYPE	SIZE		PRICE
50 Microamp.	D.C. M/C	2½in.	Flush circ., scaled 0-100	59/6
100 Microamp.	D.C. M/C	2½in.	Flush circ.	42/6
100 Microamp.	D.C. M/C.	2½in.	Flush circ., scaled "Megs."	39/6
500 Microamp.	D.C. M/C	2in.	Flush Circ. Ex 19 Set	12/6
500-0-500 mic. a.	D.C. M/C	2½in	Flush Circular, scaled 100-0-100 volts	25/-
1 Milliamp.	D.C. M/C.	2in	Flush Square. Fe/NFe.1954	22/6
1 Milliamp.	D.C. M/C	2½in.	Flush Circ. Made 1954	25/-
1 Milliamp.	D.C. M/C	3½in.	Flush Circ.	35/-
1 Milliamp.	D.C. M/C	6in.	Flush Circ. Scaled 0-12 v.	79/6
150 Milliamp.	D.C. M/C	2in.	Flush Square	7/6
200 Milliamp.	D.C. M/C	2½in.	Flush Circular	10/6
1 amp. Thermocouple		2½in.	Projecting Circular	6/9
1 Amp. Thermocouple		2½in.	Flush Circular	7/6
4 Amp. Thermocouple		2in.	Flush Square	6/9
15 Volts	A.C. M/I	2½in.	Flush Circular	8/6
300 Volts	A.C. M/I.	2½in.	Flush Circular	25/-
500 Volts	A.C. M/I	2½in.	Flush Circular	25/-
40 Amperes	D.C. M/C	2in.	Flush Circular	7/6

METER RECTIFIERS. Full wave bridge. Brand new, Salford 1 mA. **6/6.** 5 mA., **6/6.** STC 2 mA., **5/6.**

AMERICAN METERS. Triplett 100 microamp., 4in. meters, scaled as multimeter, exactly as used in Combination Tester shown opposite. Brand new, boxed, **79/6.** Post 1/6.
Triplett 100 microamp, 3in. square, flush mtg. **Scaled as output meter, 1.5 and 0-6 volts A.C.** Rectifier not fitted. Brand new, boxed, **42/6.** Post 1/-. **Westinghouse 0-5 Milliamp D.C.,** flush mtg., circular, 2in. blank black scale. Brand new, boxed, **8/6.** Post 1/-.

AMERICAN MULTIMETERS
A good general purpose portable meter by Precision, U.S.A. Basic F3D 400 micro-Amps. **Ranges: A.C. and D.C. volts 0 to 12, 60, 300, 600, 1,200 and 6,000; D.C. milli-Amps. 0 to 1.2, 12, 60 and 600; Ohms, 0 to 8 K, 800 K. and 5 Meg.; -10 to +16 dB.** In polished wooden case with carrying handle and compartment for leads, etc. Size 7½ x 7½ x 5½in. Complete with batteries, **tested and guaranteed. £6/19/6.** Post 2/6.

ADMIRALTY POWER UNITS. Equivalent to AM234. Input 200-250 v. 50 c/s. A.C. mains. **Outputs** 240 v. D.C. 125 m/Amps. and 6.3 v. A.C. 6 amps. Dual purpose 21in. panel mounted 300 v. meter reads input and H.T. volts. Double smoothing with paper capacitors. Standard 19in. rack mounting. **BRAND NEW. 79/6.** Carr. 7/6.

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Evershed and Vignoles Wee Meggers, 500 volts. Complete in leather case, with leads and instruction booklet. **BRAND NEW, £12/10/-.** Ditto, but 100 volts. **BRAND NEW, £6/10/-.**
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MINIATURE 37S IF STRIPS. For FM tuner described in "Practical Wireless." **Complete with 3 of EF91, 2 of EF92, and 1 of EB91.** A fresh release enables us to offer these once again. **BRAND NEW.** Complete reprint of **conversion** instructions and circuit supplied free. **42/6.** OR less valves, **12/6.** Post, either, 2/6.

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85 Kc/s to 25 Mc/s. A.C. mains operation. In fair condition and working order. **TF144F, £45. TF144G, £50.**

CR100 SPARES KITS

Contents: 15 valves, 2 off U50, DH63, KT63, X66, and seven KTW61 or KTW62. Output transformer, Resistors, Condensers, Potentiometers, FK screws, pilot lamps, drive cord, etc., etc. All BRAND NEW. 59/6. Post 4/6.

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CRYSTAL CALIBRATORS, Mk. 2. Ultra modern miniature design, only 9 x 7 x 6½in. Gives 1 Mc/s., 100 Kc/s., and 10 Kc/s. marker pips as selected. Requires 60 v. H.T. Controls: On/Off, Modulation On/Off. Adjust 100 Kc/s., Adjust 10 Kc/s. Supplied complete with five 1T4, one 1R5, 1 Mc/s B7G based crystal and headphones. Despatched in specially designed original transit case. **ABSOLUTELY BRAND NEW. £5/19/6.**

MARCONI LOOP AERIAL type 696. A small, compact, enclosed loop. On swivel mount with degree scale. **BRAND NEW. 69/6.** Post 2/6. Ideal for R1155, etc.

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BATTERY CHARGERS. Input 230 v. A.C. Output 12 v D.C., 1.5 amps. In neat grey metal case, 7 x 6 x 5in. **BRAND NEW, 35/-.**

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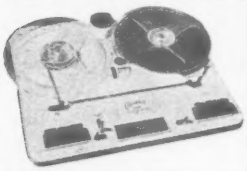
LIMITED STOCKS ONLY
The Very Latest
COLLARO MK. IV TAPE TRANSCRIPTOR



SUBJECT TO BEING UNSOLD, £24. plus 7/6 C. & P. The COLLARO Pre-Amplifier and Power Pack for use with the above deck is also available in limited quantity at **£21**, plus 3/6 P. & P. Wired to transcription, £2 extra. H.P. or CREDIT SALE TERMS AVAILABLE.

PORTABLE GRAM AMPLIFIERS

RC1.A AMPLIFIER. A small high-quality gramophone amplifier employing the latest circuitry and highly efficient miniature valves. Very neat chassis finished in bronze stove enamel. Size (overall) 5½ × 4 × 5in. Valve. 6X5, ECL82. Output 3 watts max. Controls. Volume. Tone/On/Off. For use on AC mains 200/250 v.

Price **£3/19/6** plus 2/-. P. & P.

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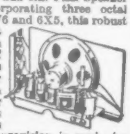
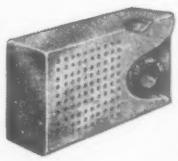
RC3A. A superior quality 3-valve amplifier employing EZ80, EL84 and ECC83. With separate Bass and Treble controls. Further details on request. Price: **£3/19/6** plus 2/6 P. & P.

RC4.A. (STALLION). This is supplied complete with high flux 8in. P.M. Speaker and Baffle. Incorporating three octal type valves 6Q7, 6V6 and 6X5, this robust and well-made unit is ideal for use in the larger type of record player and is equally suitable for use in conjunction with a radio feeder unit. Separate bass and treble controls are provided; also provision is made for an extension speaker and mains supplied to gram. motor. Output approx. 4 watts. Size overall 12in. × 4in. × 9in. high. For use on A.C mains 100/200/250 v. PRICE **£5/19/6** plus 2/6 P. & P. H.P. terms **£2/19/6** deposit and four monthly payments of **16/6**.
Fits our portable cabinet "G" at **85/-** without modification.



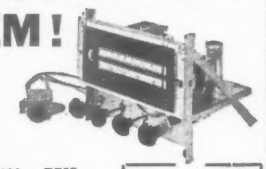
VALVES. We have perhaps the most up-to-date valve stocks in the trade. A stamp will bring complete list of brand new imported valve types, fully guaranteed. P.T. paid. Also all usual surplus types available such as 6V6GT, etc.

"R.E.P. MINI-7"
POCKET TRANSISTOR PORTABLE



AT LAST! A pocket-sized **SUPERHET** Transistor portable for medium and long-wave reception THAT REALLY WORKS, and at a price YOU can afford. The "R.E.P. MINI—7" utilises 2 White Spot, 4 Red Spot and 1 R.F. Transistor specially selected to our specification by leading manufacturer. Push-Pull output. Powered by two 3-volt miniature transistor batteries. Attractive plastic case, finished in dove grey and scarlet. Size only 5½in. × 3½in. × 1⅛in. Incorporates Hi-Grade 2½ in. P.M. Loudspeaker, Ferrite Slab Aerial, also drilled and eyeletted Paxolin Chassis. Easy to follow practical and theoretical diagrams and itemised price list available separately at 1/6, post free. Special inclusive price **£10/10/-**, Medium wave only **£9/19/6**, plus 2/6 P. & P.

★STAR ITEM!
A *NEW*
AM/FM CHASSIS
BY LEADING MANUFACTURER!

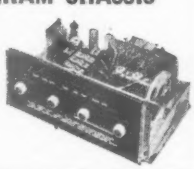


- ★ **Seven valves: ECC85, ECH81, EF85, EABC80, EL84, EZ80, EM81.**
- ★ **Long, Medium, F.M. Bands and Gram.**
- ★ **Separate bass and treble controls.**
- ★ **Illuminated volume control on extended lead.**
- ★ **Mullard F.M. Tuner Section.**
- ★ **Attractive dial in Gold on Bronze background (Vertical or Horizontal to choice)**
- ★ **Fully Guaranteed.**

£18'19'6 Plus 5/- P. & P.

This superb chassis is ideal as an up-to-the-minute replacement or as the basis of a new Radiogram. Dimensions (overall) 12in. L. × 10in. W. × 10in. D. H.P. or Credit Sale Terms Available. Limited Stocks only.

RC4.FAM. AM/FM RADIOGRAM CHASSIS



A new style AM/FM Chassis employing a printed circuit FM Tuner section. Valve line-up: 8 valves ECC85, 6BA6, 12AH8, 6BA6, 6AL5, 6AT6, EL84, 5Y3. Most attractive dial 12 × 5½in., fully illuminated with figures in green, red and white on black background. Four controls: Tuning Volume, Wavechange and Tone/On/Off. Dimensions (overall): 13 × 9 × 6in. Frequency coverage (four wavebands) 1,000-2,000 m. 200-550 m., 15-50 m., 88-100 mc/s. This is an excellent and very efficient chassis. Price **£22/10/-** plus 5/- P. & P.

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SET OF 10 HI-GRADE TWIST DRILLS. Brand new. All useful sizes from approx. 3/16in. to 1/32in. in cellophane packet. 6/- a set, plus 9d. P. & P. (Ex-W.D.).

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BARGAIN PACK (CERAMICS). 55 ceramic capacitors, 11 values, FIVE of each from 5 pf. to 5,000 pf in cellophane pack, **18/6**, post 9d.

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DECCA Lightweight pick-up complete with Studio "C" turn-over crystal insert and sapphire styli. ONLY **47/6** plus 1/6 P. & P. BRAND NEW.

9in. × 5in. ELLIPTICAL LOUDSPEAKERS. Few only. Brand new. **32/6** plus 1/6 P. & P.

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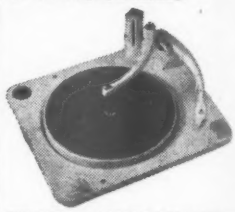
B.S.R. MONARCH. Mixer Autochanger, in cream and gold **£8/15/-**. Plus p. & p. 3/6. Stocks rapidly diminishing.



THE LATEST COLLARO "CONQUEST" 4-speed autochanger in cream with Studio "C" insert, **£8/19/6** plus P.&P. 3/6.

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COLLARO AC 2/554. Three-speed single player for A.C. mains 200/250 v. Cream finish, complete with turnover crystal pick-up incorporating the well-known high output "T" type head. Strictly limited quantity at **£6/19/6** plus 3/6 P. & P.

COLLARO 4-SPEED single record unit with separate pick-up and HGP59 crystal cartridge. Brand new, few only, **£4/12/6** plus 3/6 P. & P.

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DULCI H.3 AM/FM Chassis (6 valve) Covering Long, Medium and F.M. bands. Most attractive dial in RED and GOLD on BLACK background **£20/17/-** plus 5/- c. & p.
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We are very fortunate in being able to offer a further limited quantity of this very popular and efficient chassis at a greatly reduced price. Specification: Three wavebands, Long, Medium and Short. Valve line-up: X79, 6BA6, 6AT6, EL84, 6X4 (or equiv.). Four controls: Tone, ON/OFF, Volume, Wavechange. Tuning. Output 4 watts matched to 15 ohms. Incorporates latest Ferrite Rod Aerial. Input sockets for crystal or magnetic pick-up. Provision for mains supply to gram motor. Overall dimensions 12in. L × 7in. D × 7½in. H. Attractive dial with Red, Gold and Green lettering on Black background. Dial size 11½in. × 4½in. Price, whilst stocks last, only **£10/6** plus 3/6 P. & P. Terms available.

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We have large stocks of meters from 50 microamp to 300 v. and will be pleased to forward a complete list upon receipt of 3d. stamp.
METER RECTIFIERS 1 m/a. and 5 m/a. each at **6/6**. Brand new.

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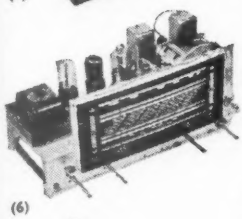
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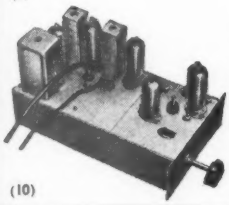
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(11)	OSRAM 912 Printed circuit F.M. Tuner	£8 8 0	2/6	2/6
(12)	JASON " ARGONAUT " AM/FM Chassis	£16 5 0	2/6	2/-
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(16)	2-amp. Battery Charger	£1 18 6	2/6	3d.
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(19)	" CRY-BABY " ALARM (Baby Alarm) (see below)	£3 12 6	2/6	1/-
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(21)	? ? ?			

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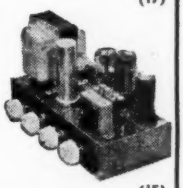
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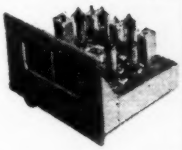
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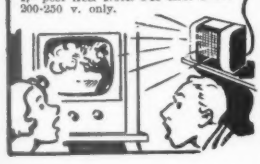
The following are also available assembled and tested:—
(2) " RAMBLER " Mains Unit, **£3/5/-**; (7) T.S.L. F.M. Tuner, **£13/15/-**; (14) F.M. Power Pack, **52/6**; (15) R.C. 3/4 watt Amplifier, **£5/5/-**; (16) 2-amp. Battery charger, **45/-**; (19) " CRY-BABY" Alarm, **89/6**; Instruction Books which contain full description, easy-to-follow practical wiring diagrams theoretical diagrams, itemised price list, etc., are supplied free of charge with all parcels but may be purchased separately if reqiired.

NOTE: (2) The " RAMBLER " Mains Unit is suitable for use with MOST all-dry portables.

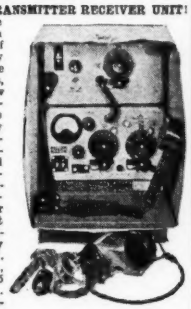
THE **CRY-BABY ALARM**

We proudly present this latest addition to our wide range of popular kits to build yourself. **Enjoy your leisure free from anxiety.** This highly efficient unit is simple to assemble, extremely sensitive and may be installed in a matter of minutes. Completely **SAFE** employing a double wound mains transformer. Attractively finished in Red and Grey (washable) " Lionide " with cream plastic escutcheon. Size only 7½in. × 3¼in. × 6¼in. Supplied in kit form complete with mike at ONLY **72/6** plus 2/6 P.&P. or assembled and tested **89/6** P. & P. 2/6. Suitable mike flex available at 3d. a yd. Instruction book and price list available separately 1/- post free. Note: For A.C. mains 200-250 v. only.



N.B.—All our T.R.F. Kit circuits include specially wound Denco " Max Q " coils on polystyrene formers. Improved performance. Price remains the same.

No. 18 TRANSMITTER RECEIVER UNIT! We have just taken delivery of a quantity of these fine units, brand new and complete. This is a very good portable, self-contained transmitter/receiver designed for short range telephony and C.W. Range, approx. 5 miles. Frequency coverage 6 mc/s.-9 mc/s. All accessories supplied i.e., Headphone, Mike, Morse Key, Aerial, comprehensive instruction book with circuit diagram. Valve line-up: 3 A.R.P.12, 2 AB8, 1 ATP4. Weight approx. 22lb. Dimensions (overall): 8in. × 10in. × 17in. **UNREPEATABLE at 99/6 plus 7/6 C. & P.**



No. 38 TRANSMITTER/RECEIVER (popular Walkie-Talkie). We have been most fortunate in obtaining a further supply of these complete stations comprising T.X./R.X. unit, headphones, microphone, aerial, junction box, battery satchel and full operating instructions. Range: approx. 5 miles. Frequency coverage 7.4-9 mc/s. ABSOLUTELY BRAND NEW, 65/-. Export enquiries invited.

SPECIAL PURCHASE from MINISTRY BRAND NEW No. 17 Mk. II TRANSMITTER/RECEIVER. Built into strong wooden cabinet 15in. × 14in. × 9in. Complete with headphones and microphone. Range 5-8 miles with simple aerial. Frequency coverage 44-61 mc/s. (5-7 metres) Uses standard 120 v. H.T. and 2-volt L.T. batteries. Complete with full operating instructions. 59/6.

CONSTRUCTOR'S NOTE!!
RADIO DATA BOOKS AVAILABLE, i.e., Valve guide, Colour code, etc. Send stamp for list.

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CLYNE RADIO LTD.

18 Tottenham Court Road, London, W.1.
and at
162 Holloway Road, London, N.7.

CATALOGUE

To: Name .....
Address .....
.....
.....

W

ENCLOSED HEREWITH **2/-**

DATE

CUT OUT ALONG DOTTED LINE

SELENIUM RECTIFIERS

L.T. Types

2/6 v. ½ a.h.w.	1/9
6/12 v. ½ a.h.w.	2/9

F.W. Bridge

6/12 v. 1 a. ..	4/11
6/12 v. 2 a. ..	9/9
6/12 v. 3 a. ..	11/9
6/12 v. 4 a. ..	14/9
6/12 v. 6 a. ..	19/9
6/12 v. 10 a.	25/9

H.T. Type H.W.

120 v. 40 mA.	3/9
250 v. 50 mA.	5/9
250 v. 80 mA.	7/9
350 v. 60 mA.	7/9
250 v. 250 mA.	10/9

BATTERY CHARGING EQUIPMENT

ASSEMBLED CHARGERS

6 v. 1 a.	19/9
6/12 v. 1 a.	27/9
6 v. 2 a.	29/9
6/12 v. 2 a.	38/9
6/12 v. 4 a.	56/9

Above ready for use with mains and output leads. Cases well ventilated and finished in stoved blue hammer. Carr. and packing. 3/6.

BATTERY CHARGER KITS Consisting of Mains Transformer F.W. Bridge. Metal Rectifier, well ventilated steel case. Fuses, Fuse-holders, Grommets, panels and circuit. Carr. 2/6 extra.

6 v. or 12 v. 1 amp. ..	22/9
6 v. 2 amps	25/9
6 v. or 12 v. 2 amps. ..	31/6
6 v. or 12 v. 4 amps. ..	53/9

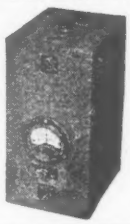
BATTERY CHARGER KIT Consisting of F.W. Bridge Rectifier 6/12 v. 5 a. Mains Trans. 0-9-15 v. 6 a. output, and ammeter. Only 49/9. Post 3/-.

ASSEMBLED CHARGER 6 v. or 12 v. 2 amps.

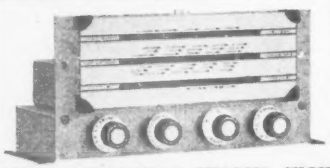
Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case, finished attractive hammer blue. Ready for use with mains and output leads. Double Fused. Only **49/9** Carr. 3/6.

All for A.C. Mains 200-250v., 50 c/s. Guaranteed 12 months

Assembled 6v. or 12v. 4 amps.



Fitted Ammeter and variable charge selector. Also selector plug for 6 v. or 12 v. charging. Double fused. Well ventilated steel case with blue hammer finish. Ready for **75/-** use with mains and output leads. Carr. 3/9. Or Deposit 30/- and four monthly payments 13/-.



AM/FM RADIOGRAM CHASSIS, HIGH QUALITY. PUSH PULL. 6-8 WATTS OUTPUT

Current manufacture. 12 months' guarantee. For 200-250 v mains. Covers L and M. Wavebands plus F.M. Includes 8 latest type miniature B.V.A. valves. Only 22 **gns.** plus 7/6 carr. Or deposit £2/12/- and 9 monthly payments of £2/12/-. Guaranteed 12 months.

CO-AXIAL CABLE. 75 ohms, ½in., **8d. yard.** Twin screened feeder **11d.** yard.

ELECTROLYTICS (current production) Not Ex-Govt.

Tubular Types		Can Types	
8 mfd. 450 v.	1/9	16 μF 450 v.	2/9
8 mfd. 500 v.	2/6	16 mfd. 500 v.	3/9
16 μF 350 v.	1/11	32 μF 350 v.	2/11
16 μF 450 v.	2/9	32 mfd. 450 v.	4/9
16 μF 500 v.	3/9	100 mfd. 450 v.	4/9
8-16 μF 500 v.	4/11	8-8 μF 450 v.	2/11
25 μF 25 v.	1/3	8-16 μF 450 v.	3/11
50 μF 12 v.	1/3	16-16 μF 450 v.	3/11
50 mfd. 25 v.	1/9	32-32 μF 350 v.	4/9
50 μF 50 v.	1/9	32-32 μF 450 v.	5/9
100 mfd. 12 v.	1/9	100-100 mfd. 350 v.	5/9
100 mfd. 25 v.	2/3	150 mfd. 450 v.	5/9
3,000 mfd. 6 v.	3/9	100-200 mfd. 275 v.	6/11
6,000 mfd. 6 v.	3/11		

Many others in stock.

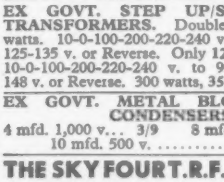
VOLUME CONTROLS with long spindles, all values, less switch, 2/9; with S.P. switch, 3/9.

EX GOVT. STEP UP/STEP DOWN TRANSFORMERS. Double wound 80/100 watts. 10-0-100-200-220-240 v. to 5-0-75-115-125-135 v. or Reverse. Only 12/9 plus 2/9 post 10-0-100-200-220-240 v. to 9-0-110-122-136-148 v. or Reverse. 300 watts, 35/9, plus 7/6 carr.

EX GOVT. METAL BLOCK PAPER CONDENSERS

4 mfd. 1,000 v. .. 3/9 8 mfd. 500 v. .. 4/6
10 mfd. 500 v. 3/9

THE SKY FOUR T.R.F. RECEIVER



A design of a 3 valve 200-250 v. A.C. Mains L. & M. wave T.R.F. receiver with selenium rectifier. For inclusion in cabinet illustrated or walnut veneered type. It employs valves 6K7, SP61, **6F6G**, and is specially designed for simplicity in wiring. Sensitivity and quality is well up to standard. Point-to-point wiring diagrams, instructions and parts list, 1/9. This receiver can be built for a maximum of £4/19/6 including cabinet. Available in brown or cream bakelite, or veneered walnut.

EX GOVT. VIBRATOR UNITS. 12 v. input 280 v. output. Suitable for car radio etc., 16/6.

VIBRATORS. Oak and Wearite. Synchronous 7 pin 2 v. 7/9, 6 v. 8/9.

EX. GOVT. 50 WATT AMPLIFIERS. Brand new. For 200-250 v. 50 c.p.s A.C. mains. Designed for speech only but with suitable pre-amp, could be used with Gram. or Radio. Valves included. Four 6L6s used for output. Complete with hand microphone with good length of lead. Unused in original transit cases. Only 9 **gns.** Ready for use. Carr. 15/-.

RE-ENTRANT SPEAKERS. Tannoy 8 watt, 7.5 ohms suitable for above, 25/- each.

EX GOVT. MAINS TRANSFORMERS All 200-250 v. 50 c/s. input.

250-0-250 v. 60 mA., 6.3 v. 3 a., 6.3 v. 1 a. Potted 4½-3½-3in.	11/9
Pr. 0-110-200-230-250 v., 275-0-275 v. 100 mA., 6.3 v. 7 a., 5 v. 3 a.	21/9
230-0-230 v. 80 mA., 12.6 v. 1.5 a. 5 v. 2 a.	11/9
250-0-250 v. 150 mA. 5 v. 3 a.	16/9
350-0-350 v. 160 mA. 6.3 v 5 a. 5 v. 3 a.	27/9
400-0-400 v 250 mA. 5 v. 2 a., 5 v. 2 a.	18/9
450-0-450 v. 150 mA. 6.3 v. 5 a., 6.3 v. 1 a., 5 v. 3 a.	29/9
450-0-450 v. 250 mA. 6.3 v. 3 a., 6.3 v. 1 a., 5 v. 6 a.	49/9
12.5 v. 3 a., 5 v. 3 a.	12/9

MANUFACTURERS' SURPLUS TRANSFORMERS. Primary 230-250 v. Drop through type 325-0-325 v 100 mA., 6.3 v. 2.5 a., 5 v. 2 a. 17/9. Post 2/9.

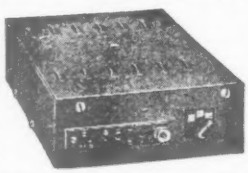
EX GOVT. SMOOTHING CHOKES

250 mA., 20 H., 150 ohms	19/6
250 mA., 5 H., 50 ohms	12/9
150 mA., 10 H., 50 ohms	10/11
120 mA., 12 H., 100 ohms	9/9
100 mA., 10 H., 100 ohms	6/9
100 mA., 5 H., 100 ohms, tropicalised..	3/11
50 mA., 50 H., 1,000 ohms	6/9

EX GOVT. CASES. Well ventilated, black crackle finished, undrilled cover. Size 14 × 10 × 8½in. high. IDEAL FOR BATTERY CHARGER OR INSTRUMENT CASE, COVER COULD BE USED FOR AMPLIFIER. Only 9/9, plus 2/9 post, Size 13½in. × 8in. × 6½in. with undrilled perforated cover finished in stoved grey enamel, 7/9, plus 2/9 post. **SPECIAL OFFERS.** Small 2 gangs .005 mfd., 4/9. Electrolytics 32-32-32 mfd. 250 v., 2/9 each or in lots of six, 2/3 each.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all dry battery eliminator. Size 5¼ × 4¼ × 2in. approx. Completely replaces batteries supplying 1.4 v. and 90 v. where A.C. mains 200-250 v. 50 c/s. is available. **Suitable for all battery portable receivers requiring 1.4 v. and 90 v.** This includes latest low consumption types. Complete kit with diagram. 39/9 or ready for use 46/9.



Type BM2. Size 8 × 5½ × 2¼in. Supplies 120 v., 90 v., and 60 v., 40 mA. and 2 v. 0.4 a. to 1 amp. fully smoothed **THEREBY COMPLETELY REPLACING BOTH H.T. BATTERIES AND L.T. 2v. ACCUMULATORS** when connected to A.C. mains supply 200-250 v. 50 c/s. SUITABLE FOR ALL BATTERY RECEIVERS normally using 2 v. accumulator. Complete kit with diagrams and instructions, 49/9, or ready for use, 59/6.

JUNCTION TRANSISTORS For R.F. 17/6. A.F. 7/9.

MINIATURE MOTORS. 24/28 v. D.C. A.C. Size only 2½ × 1½in. Spindle 1¼in. long, ¼in. diam. Made by Hoover Ltd., Canada. Price only 9/9.

M.E. SPEAKERS. 2-3 ohms R.A. 8in. Field 600 ohms., 11/9.

R.S.C. TRANSFORMERS

FULLY GUARANTEED. INTERLEAVED AND IMPREGNATED.

MAINS TRANSFORMERS Primaries 200-230-250 v. 50 c/s.

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250 v. 60 mA., 6.3 v. 2 a., 5 v. 2 a.	17/6
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9
250-0-250 v. 100 mA., 6.3 v. 6 a., 5 v. 3 a., for R1355 conversion	31/-
300-0-300 v. 100 mA., 6.3 v. 4 a. 5 v. 3 a.	25/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
300-0-300 v. 130 mA., 6.3 v. 4 a., c.t., 6.3 v 1 a., suitable for Mullard 510 Amplifier	33/9
375-0-375 v. 150 mA., 6.3 v. 4 a., 5 v. 2 a.	29/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	33/9
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a.	33/9
425-0-425 v. 200 mA., 6.3 v. 4 a., c.t., 6.3 v. 4 a., c.t., 5 v. 3 a., suitable Williamson Amplifier, etc.	49/9

TOP SHROUDED DROP-THROUGH TYPE

260-0-260 v. 70 mA., 6.3 v. 2 a., 5 v., 2 a.	16/9
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a	18/9
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	22/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9
350-0-350 v. 100 mA. 6.3 v. 4 a., 5 v. 3 a.	23/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	29/9

ELIMINATOR TRANSFORMERS Primaries 200-250 v. 50 c/s.

120 v. 40 mA., 5-0-5 v. 1 a.	14/9
90 v. 15 mA., 6-0-6 v. 250 mA.	9/11

FILAMENT TRANSFORMERS Primaries 200-250 v. 50 c/s.

6.3 v. 1.5 a.	5/9	6.3 v. 3 a.	8/11
6.3 v. 2 a.	7/6	6.3 v. 6 a.	17/6
0-4-6.3 v. 2 a. ..	7/9	12 v. 3 a. or	
12 v. 1 a.	7/9	25 v. 1.5 a. ..	17/6

CHARGER TRANSFORMERS All with 200-230-250 v. 50 c/s. Primaries: 0-9-15 v. 1½ a., 11/9; 0-9-15 v. 3 a., 16/9; 0-9-15 v. 5 a., 19/9; 0-9-15 v. 6 a., 23/9.

OUTPUT TRANSFORMERS

Midget Battery Pentode 66:1 for 3S4, etc.	3/6
Small Pentode 5,000 Ω to 3 Ω	3/9
Standard Pentode, 5,000 Ω to 3 Ω	4/6
Standard Pentode, 8,000 Ω to 3 Ω	4/9
Push-pull 8 watts 6V6 to 5 ohms	8/9
Push-pull 10-12 watts 6V6 to 3 Ω or 15 Ω	15/9
Push-pull 10-12 watts to match 6V6 to 3-5-8 or 15 Ω	16/9
Push-pull EL84 to 3 or 15 ohms	16/9
Push-pull 15-18 watts, sectionally wound, 6L6, KT66, etc., to 3 or 15 ohms	21/9
Push-pull 20 watt high-quality sectionally wound, 6L6, KT66, etc. to 3 or 15 Ω	47/9

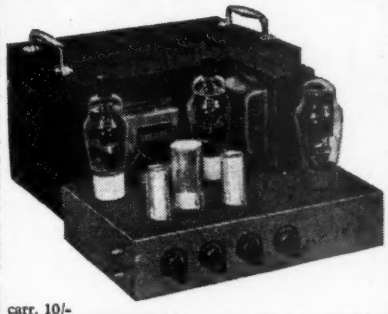
SMOOTHING CHOKES

250 mA., 5 H., 100 ohms	11/9
150 mA., 7-10 H., 250 ohms	11/9
100 mA., 10 H., 200 ohms	8/9
80 mA., 10 H., 350 ohms	5/6
60 mA., 10 H., 400 ohms	4/11
1 amp. 0.5 ohm. L.T. type	6/6

XUM

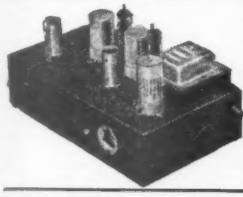
R.S.C. A10 ULTRA LINEAR 30 WATT AMPLIFIER

HIGH FIDELITY PUSH-PULL UNIT EMPLOYING SIX VALVES. EF86, EF86, ECC83, 807, 807, GZ34. Tone Control Pre-amp stages are incorporated. Sensivitity is extremely high. Only 12 millivolts minimum input is required for full output. **THIS ENSURES THE SUITABILITY OF ANY TYPE OR MAKE OF MICROPHONE OR PICK-UP.** Separate Bass and Treble controls give both "lift" and "cut" with ample tone correction for long playing records. An extra input with associated vol. control is provided so that two separate inputs such as "mike" and gram., etc., etc., can be simultaneously applied for mixing purposes. **AN OUTPUT SOCKET WITH PLUG IS INCLUDED FOR SUPPLY OF 300 v. 20 mA. and 6.3 v. 1.5 a. FOR A RADIO FEEDER UNIT.** Price in kit form with easy-to-follow wiring diagrams. Cover as illustrated 18/9 extra. Only **£10/19/6** carr. 10/- Or Factory built with 12 months' guarantee **£13/13/-.** **TERMS ON ASSEMBLED UNITS. DEPOSIT 36/-** and 9 monthly payments of 31/-.



Type 807 output valves are used with High Quality Sectionally wound output transformer specially designed for Ultra Linear operation. Negative feedback of 20 D.B. in main loop. **CERTIFIED PERFORMANCE FIGURES ARE EQUAL TO MOST EXPENSIVE UNITS AVAILABLE.** Frequency response ± 3 D.B., 30-20,000 c/cs., Tone Controls ± 12 D.B. at 50 c/cs., + 12 D.B. to − 6 D.B. at 12,000 c/cs., Hum and noise 70 D.B. down. Good quality reliable components used. Chassis finish blue hammer. Overall size 12 × 9 × 9in. approx. Power consumption 150 watts. For A.C. mains 200-230-250 v. 50 c/cs. Outputs for 3 and 15 ohm speakers. **EQUALLY SUITABLE FOR THE CONNOISSEUR OR FOR LARGE HALLS, CLUBS, or OUTSIDE FUNCTIONS. IDEAL FOR USE WITH MUSICAL INSTRUMENTS SUCH AS STRING BASS, ELECTRONIC ORGAN, GUITAR, etc. FOR DANCE BANDS, GARRISON THEATRES, etc. Microphones, Speakers, etc., at keen cash prices or on terms with amplifiers. etc. We can supply**

EXPORT ENQUIRIES INVITED



LINEAR LT/45 HIGH QUALITY TAPE DECK AMPLIFIER COMPLETE with POWER PACK and OSC. STAGE. Suitable for Collaro, Lane, Truvox, Aspden, Brennell, etc., etc. State make of Deck when ordering. Chassis size 12-7-3in Overall size 12-7-6½in. For 200-250 v. 50 c/cs. A.C. mains. Output for standard 2-3 ohm speaker. Only 15 millivolts input required for full recording. Only 2 millivolts minimum output required from recording head. Magic Eye recording level indicator. Provision for feeding P.A. amplifier. Negative feed-back equalisation. Linear frequency response ± 3 D.B 50-11,000 c/cs. Facilities for recordings at 15in., 7½in or 3¾in. per second. Automatic equalisation at the turn of a knob. When switching from record to playback position automatic demagnetisation of heads is assured. Separate gain and output controls. Valves type ECC83, ECC83, EL84, EZ80, EM34. Output 4 watts. Unit supplied with maker's 12 months' guarantee. We know of no other make which represents the same exceptional value. Leaflet 6d.

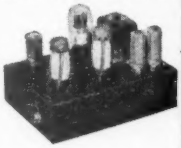
12 Ready for use **GNS.** Carr. 7/6.

COLLARO JUNIOR 4 SPEED RECORD PLAYER with separate pick-up having dual point sapphire stylus. Brand new, cartoned. For 200-250 v. A.C. mains only **£4/12/6.** Carr. 3/6.

PICKUP ARMS. Acos GP54 lightweight turnover type with HGP59/52 cartridge cream finish. Only **29/9.**

L63 MINIATURE 3 WATT GRAM. AMPLIFIER For 200-250 v. 50 c.p.s. A.C. Mains. Overall size only 6½ × 4½ × 3¾in. Fitted vol. and Tone Control with mains switch. Designed for use with any kind of single player or record changing unit. Output for 2-3 ohms speaker. Guaranteed 12 months. Only 55/9.

R.S.C. A5 4-5 WATT HIGH GAIN AMPLIFIER



A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high-fidelity pick-up heads in addition to all other types of pick-ups and practically all mikes. Separate Bass and Treble controls are provided. These give full long playing record equalisation. Hum level is negligible being 71 D.B. down. 15 D.B. of negative feedback is used. H.T. of 300 v. 26 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit or Tape Deck pre-amplifier. For A.C. mains input of 200-230-250 v. 50 c/s. Output for 2-3 ohm speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with the blue hammer finish, and point-to-point wiring diagrams and instructions. Exceptional value at only **£4/15/-,** or assembled ready for use **25/-** extra, plus 3/6 carriage. Or Deposit **22/-** and five monthly payments of **22/-** for assembled unit.

R.S.C. A7 3-4 WATT QUALITY AMPLIFIER A highly sensitive 4-valve amplifier using negative feedback and having an excellent frequency response. Pre-amplifier and Tone Control stages are incorporated with separate Bass and Treble controls giving full tone compensation for long playing records. Suitable for any kind of pick-up including latest high fidelity types. H.T of 250 v. 20 mA and L.T. 6.3 v. 1 a, available for supply of Radio Feeder Unit, etc. ONLY 40 millivolts input required for full output. Fully isolated chassis with baseplate. For A.C. mains 200-250 v. 50 cycles. Output for 2-3 ohm speaker. Complete kit of parts with point-to-point wiring diagrams and instructions. Only **£3/15/-,** carr. 3/6 or factory built **22/6** extra.

SENSATIONAL OFFER

STAAR GALAXY 4-SPEED MIXER AUTO-CHANGERS

A precision manufactured unit with unique finger tip control. Pick-up fitted with dual sapphire tipped stylus. A very compact changer in attractive duo-tone finish. For A.C. mains 110—250v. Brand new, cartoned. **£3/19/6.** *Post 3/9.*

COLLARO 4-SPEED AUTO-CHANGERS With studio pick-up with turnover head. BRAND NEW. Cartoned, latest model. For 200-250 v. A.C. mains. Very limited number. Conquest **£8/19/6.** Continental **9 Gns.** Carr. 5/6.

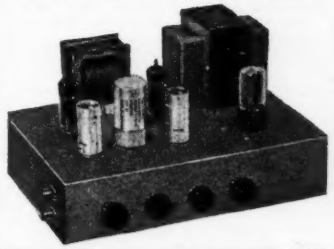
COLLARO RC54 3 SPEED AUTO-CHANGER As above unit but for normal 3-speed requirements. Brand new cartoned but for 110 v. 50 c.p.s. A.C. mains. So that the unit can be operated from normal 200-250 v. A.C. mains we are supplying free with every changer a suitable auto-transformer with input and output voltages clearly marked. Limited number only. **7 GNS.** Carr. 5/6.

LINEAR L45 MINIATURE 4/5 W. QUALITY AMPLIFIER. Suitable for use with Garrard R.S.R. or any other record playing unit and most microphones. Total negative feedback 12 D.B. Separate Bass and Treble controls. For A.C mains input of 200-250 v. 50 c.p.s. Output for 2/3 ohm speaker. Three miniature Mullard valves used. Size only 6 × 5 × 5¼in. high. Chassis fully isolated from mains. Guaranteed 12 months. Only **£5/19/6.** Or Deposit **23/-,** and five monthly payments of **23/-.** Send S.A.E. for leaflet.

PLESSEY DUAL CONCENTRIC 12in. P.M. SPEAKERS

(15 ohms), consisting of a high quality 12in. speaker of orthodox design supporting a small elliptical speaker ready wired with choke and condensers to act as tweeter. This high fidelity unit is highly recommended for use with our A11 or any similar amplifier. Rating is 10 watts. Gauss 12,000 lines. Price only **£5/17/6.** Or Deposit 13/- and nine monthly payments of 13/-.

A11 ULTRA LINEAR 12-14 WATT AMPLIFIER



NEW 1958 DESIGN HIGH-FIDELITY PUSH-PULL AMPLIFIER WITH "BUILT-IN" TONE CONTROL PRE-AMP. STAGES

Two input sockets with associated controls allow mixing of "mike" and gram. as in A10. High sensitivity. Includes 5 valves, ECC83 ECC83, EL84, EL84, 5Y3, High Quality sectionally wound output transformer specially designed for Ultra Linear operation, and reliable small condensers of current manufacture. **INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut"** Frequency response ±3 DB 30-30,000 c/cs. Six negative feedback loops. Hum level 60 DB down **ONLY 23 millivolts INPUT** required for **FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones.** Comparable with the very best designs. For **STANDARD or LONG PLAYING RECORDS.** For **MUSICAL INSTRUMENTS** such as **STRING BASS, GUITARS** etc. **OUTPUT SOCKET** with plug provides 300 v. 30 m.a. and 6.3 v. 1.5. a. For supply of a **RADIO FEEDER UNIT.** Size approx. 12-9-7in. For A.C. mains 200-230-250 v. 50 c/cs. **Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis** is fully punched. **Full instructions** and point-to-point wiring diagrams supplied.

Only **8 GNS.** or factory built 45/- extra. Carr. 10/-. If required louvred metal cover with 2 carrying handles can be supplied for 18/9. **TERMS ON ASSEMBLED UNITS. DEPOSIT 25/6** and nine monthly payments of **25/6.** Send S.A.E. for illustrated leaflet detailing Ready-to-assemble Cabinets, Speakers, Microphones etc., with **cash** and credit terms.

LINEAR "DIATONIC" 10-WATT HIGH FIDELITY AMPLIFIER. Incorporating pre-amp For A.C. mains input 200-230-250 v. 50 c.p.s. A compact attractively finished unit with two separately controlled inputs and outputs for 3 and 15 ohms speakers. Separate Bass and Treble controls. Five latest type miniature Mullard valves. Only **12 Gns.** Send S.A.E. for leaflet and credit terms.

W.B. "STENTORIAN" HIGH FIDELITY P.M. SPEAKERS. HF1012, 10 watts 15 ohm (or 3 ohm) speech coil. Where a really good quality speaker at a low price is required, we highly recommend this unit with an amazing performance. **£4/10/9.** Please state whether 3 ohm or 15 ohm required.

P.M. SPEAKERS. 2-3 ohm 5in. Goodmans **17/9.** 7 × 4in. Elliptical **19/6,** 6½in. Rola, **19/9,** 8in. **Rola, 19/9,** 8in. Goodmans **21/9.** 10in. R.A. **28/9.** 12in. **Plessey 29/11.** 12in. Plessey 3 ohms, 10 watts, 12,000 lines, **59/6.**

SUPERHET RADIO FEEDER UNIT Design of a high quality Radio Tuner Unit (specially suitable for use with any of our Amplifiers). A Triode Heptode F/changer is used. Pantode I F. and double Diode Second Detector, delayed A.V.C. is arranged so that A.V.C. distortion is avoided. The W Ch. 8w. incorporates Gram. position. Controls are Tuning, W. Ch., and Vol. Output will load most Amplifiers requiring 500 mV. input depending on Ac location. Only 250 v. 15 mA. H.T. and L.T. of 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9-6-7in. high. Send S.A.E. for illustrated leaflet. Total building cost is **£4/15/-.** Point-to-point wiring diagrams and instructions, **2/6.**

Radio Supply Co. (LEEDS) LTD.

Personal Shoppers to **MAUDE ST.** (Opposite Parish Church School) **LEEDS, 2.**
Mail Orders to **29-31, Moorfield Road, LEEDS, 12.**

Terms: C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/9 extra and all orders under £2. 2/9 extra under £5 unless carriage charge stated. Full Price List 6d. Trade List 5d. Open to Callers: 9 a.m. to 5.30. p.m. Saturday until 1 p.m. S.A.E. please with all enquiries.

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G.W. SMITH & CO (RADIO) LIMITED

Phone: GERRARD 8204/9155
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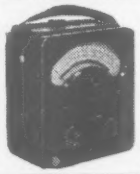
3-34 LISLE STREET, LONDON, W.C.2

UNIVERSAL AVOMETER MODEL "D"



10 D.C. volt ranges, 150 Mv. to 1.5 kv. 8 A.C. volt ranges 7.5 v. to 1.5 kv. 8 D.C. current ranges, 15 ma. to 30 amps. 6 A.C. current ranges, 75 ma. to 15 amp. Resistance ranges, 1K. and 10 K. ohms. Supplied in perfect order with instructions and leads. **£8/19/6.** each. P/P. 4/-.

ADVANCE CONSTANT VOLTAGE TRANSFORMERS. Input 190 to 260 volts. A.C. 50 cycles. Output constant at 230 volts. Max. rating 150 watts. Supplied brand new in original crates. **£8/10/-** each. P/P 5/-.

TRIPLETT 100 MICROAMP 4in. METERS. Square face, flush fitting. Scaled volts, ohms, ma. Ideal for test meter. Brand new **79/6** each. P/P. 1/6.

HEAVY DUTY AUTO TRANSFORMERS. 110/230 volts, 750 watts. Brand new, only **69/6** each. P/P. 5/-. Also 100 watts, **15/6**, 150 watts **21/-**. P/P. 1/6.

POST OFFICE TELEPHONE HANDSETS. Standard type, brand new, boxed, **12/6** each. P/P. 1/3.

TAYLOR 6in. 50 MICROAMP METERS. Square face, flush fitting. Brand new, boxed, **£5/19/6** each. P/P. 1/6.

2 VOLT 3 A.H. ACCUMULATORS. Exide, new, unfilled, 2/- each. P/P. 1/-. Block of 12 **21/-**. P/P. 4/6.

JOHNSON TX. CONDENSERS. 500 PF variables. Brand new, boxed, **15/6** each. P/P. 1/-. New, boxed, Johnson variable inductances, **22/6**. P/P. 2/6.

AMERICAN SUPER LIGHTWEIGHT HEADPHONES. Res. 50 ohms. Fitted with rubber earmoulds to fit inside the ear, extremely good quality, ideal for communication receivers, etc. New and boxed. **15/-** pair. P/P. 1/-.

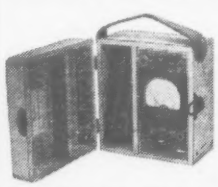
FERRANTI POTTED FILAMENT TRANSFORMERS. Hermetically sealed, ceramic terminations. All new and boxed. Type 1.200/250 v. input. Output 6.3 v. CT. 5.6 a., tapped 5 v. 6.3 v. CT. 4.8 a. tapped 4 v. 6.3 v. CT. 1 a. tapped 4 v., **19/6** each. Type 2. Input 200/250 v. Outputs, 6.3 v. CT. 3.3 a. tapped 5 v. 6.3 v. CT. 1 a. tapped 4 v. 6.3 v. CT. .9 a. 6.3 v. CT. .6 a., **15/6** each. P/P. 2/- each type.

L.T. TRANSFORMER BARGAINS. Type 1. 200/250-volt input. Output tapped 3, 6, 9, 12, 24 or 36 volts 5 amps. **35/-** each. P/P. 3/-. Type 2. 200/250 volt input. Output 12 volts 5 amps. **12/6** each. P/P. 2/-.

AR.88 WAVECHANGE SWITCHES. Spare for Model D. Ceramic 8 bank, 6 pos., complete with all screens. Brand new. **17/6** each. P/P. 2/6.

AVO MINOR LEATHER CASES. Brand new. **7/6** each. P/P. 1/-.

AMERICAN MULTI-RANGE TEST METERS



1,000 ohms per volt. 400 micro-amp basis movement. Ranges volts. A.C. or D.C. 2.5, 10, 50, 250, 1,000 and 5,000 v. D.C. current. 1 ma., 10 ma., 100 ma. and 1 amp. Ohms 500, 100 k. and 1 meg. Decibels, −10 to +69. Complete with test prods and instructions. As new, tested before despatch. **£5/19/6** each. P/P. 3/-.

AVO BATTERY ELIMINATOR POWER PACKS. Operation 200/250 volts A.C. Output 1.4 volts at 300 ma. and 67 volts at 10 ma. Stabilised by VS70, whole unit fully fused. Size 8½ × 5 × 3¼in. Ideal for personal battery sets, etc., supplied brand new in maker's cartons, **39/6** each. P/P. 2/6.

TAYLOR MODEL 160A OUTPUT METER. Incorporates 4in. meter calibrated 0–25 mW. Meter multiplier, .01-.1-1.0-10-100. Impedance matching 2.5-5-100-125-150-600-4,000-8,000-10,000-20,000 ohms. Supplied brand new, boxed and tested, **£14/10/-** each. P/P. 5/-.

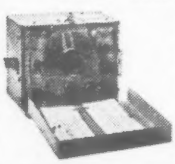
COSSOR DOUBLE BEAM OSCILLOSCOPE TYPE 339

Operation 110/200/250 volts A.C. 120 watts. Time Base 10 positions. 6 cps. to 250,000 cps. Amplifier 10 cps. to 2,000,000 cps. Sensitivity, Y1.Y2.3.1 v. D.C. 1.1 v. rms. X. 2.25 v. D.C. .8 v. rms.

Supplied in good working order, complete with handbook and circuit. **£27/10/-** each. P/P. £1.

I.F. ALIGNMENT OSCILLATORS A laboratory instrument, sub-standard accuracy, three ranges 455, 465 and 475 kc/s., with dial readings of ± 10 kc/s. on each range. 465 kc/s. crystal check. 30% internal modulation at 150 or 400 cycles. Variable attenuation from .1 microvolt to 1 volt. 1 DB to 100 DB. 200–250 volts A.C. operation, supplied brand new, boxed, **£15** each. P/P. 10/-.

W.1191 WAVEMETERS



Portable precision battery operated frequency check meters, coverage 100 kc/s. to 20 mc/s. Supplied complete with all valves and 1 mc/s. Xtal and calibration charts. **£5/19/6** each. P/P. 6/-.

RCA ET.4336 PLATE TRANSFORMERS. Special release, brand new in original maker's transit cases. Primary tapped 200 to 250 volts 50 cycles. Secondary 2,000/0/2,000 volts 400 ma., tapped 1,500/0/1,500 volts Price **£12/10/-** each. P/P. £1.

A.C. MAINS VOLTAGE REGULATOR TRANSFORMERS. Input 230 volts. Output variable from 185 to 250 volts at a max. rating of 24 amps. Ideal for laboratory use, etc., supplied as new. **£15** each. P/P. 10/-.

MUIRHEAD PRECISION STUD SWITCHES. Brand new and boxed. 4 banks, each bank 24 position. Heavy duty contacts. Only **17/6** each. P/P. 1/6.

EDDYSTONE MAINS POWER PACKS S.441B. Supplied brand new and unused. Input 200/250 volts. Output 300 volts 200 ma. and 12 volts 3 amps. Double choke and condenser smoothed, 5U4 rectifier. Housed in grey metal case, fully fused, indicator, etc. Only **49/6** each. P/P. 6/-.

ALKALINE NIFE ACCUMULATORS

Banks of 10 cells giving 12 volts 45 A.H. Unused in wooden crates, **£5/10/-** each. P/P. 7/6.

Size: 26½" × 8½" × 5½".

"C" CORE TRANSFORMERS Special offer, all brand new and boxed. All types have 230 volts 50 cycle input. Type 1. 510/0/510 v. 300 ma., 375/0/375 v. 100 ma., 6.3 v. 9 a., 2 × 6.3 v. 2 a., 2 × 6.3 v. 1 a., 6.3 v. 1.5 a. 6.3 v. .5 a., 5 v. 3 a., **82/6.** P/P. 5/-. Type 2. 450/0/450 v. 250 ma., 2 × 6.3 v. 5 a., 2× 6.3 v. 1 a., 5 v. 4 a., **65/-.** P/P. 4/6. Type 3. 450/0/450 v. 220 ma., 6.3 v. 6 a., 6.3 v. 3 a., 5 v. 3 a., **59/6.** P/P. 4/-. Type 4. 350/0/350 v. 400 ma., 25 v. 1 a., 21 v. .5 a., 6.3 v., 5 a., 6.3 v. 1 a. 5 v. 4 a., **65/-.** P/P. 4/6. Type 5. 360/0/360 v. 200 ma., 360/0/360 v. 65 ma., 6.3 v. CT. 5 a., 6.3 v. CT. 2 a., 6.3 v. 5 a., 5 v. 4 a., 5 v. 3 a., **65/-.** P/P. 4/6.

"C" CORE CHOKES. 20H, 80 ma., 16H. 120 ma., 10H 250 ma., 100H 30 ma. All types **10/6** each. P/P. 2/-.

6-VOLT VIBRATOR POWER PACKS. Output 120 volts 30 ma. Fully smoothed, uses standard 4-pin Mallory vibrator. New and boxed. **12/6** each. P/P. 2/6.

"C" CORE E.H.T. TRANSFORMERS. Type 1, 3,850 v. 5 ma., 4 v. 2.5 a., 4 v. 1 a., **52/6.** P/P. 3/-. Type 7. 1,250/0/1,250 v. 5.5 ma., 6.3 v. 1 a., 6.3 v. 1 a., 4 v. 1 a., **42/6.** P/P. 2/6.

AMERICAN ROTARY TRANSFORMERS. Models available for either 6 or 12 volt D.C. Input. Output 250 volts 80 ma. Ideal for car radios or razors, etc., new and unused, **22/6** each. P/P. 3/-.

NATIONAL R.F. CHOKES. Tx. type, ceramic former, new boxed, **4/6.** P/P. 9d.

AMERICAN GEARED MOTORS. American 24 volt D.C. motor with built-in precision gearbox giving twin outputs 20 r.p.m. and 6 r.p.m Will also operate on 12 v. giving reduced outputs. Size 7 × 1¾in. Shaft dia. ¼in. Supplied brand new only. P/P. 3/-. **19/6** each.

MARCONI TF-643 SUB-STANDARD WAVEMETERS. Frequency coverage 20 to 300 mc/s. in 4 bands. Supplied as new with all coils and calibration charts. **£19/10/-** each. P/P. 6/-.

R.1155 SUPER SLOW MOTION DRIVES. Improved version as fitted to Models L and N. Suitable for Model A, etc. Brand new **12/6** each. P/P. 1/-.

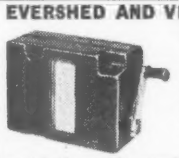
MIDGET KNIFE ACCUMULATORS. Single cells, 1.2 v. 3 A.H. New 5/- each. P/P. 1/-.

SYNCHRONOUS MAINS MOTORS. 200/250 v. A.C, Output 1 R.P.M. fitted with microswitch and cam. **32/6** each. P/P. 2/-.

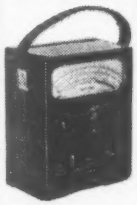
AVO MODEL 7 MULTIPLIERS. Extends 1,000-volt range to 4,000 volts. New, boxed, 5/6 each. P/P. 1/-.

MUIRHEAD VERNIER DRIVES. Brand new, 7/6 each. P/P. 1/-.

EVERSHED AND VIGNOLES WEE-MEGGER 500 VOLTS. Special release, brand new and unused, complete with leather carrying case, only **£12/10/-** each. P/P. 2/6. Also available secondhand models, but perfect working order complete with leather case, **£8/10/-** each. P/P. 2/6.



G.E.C. SELECTEST MULTI-RANGE METERS. Basic movement 1 ma. 1,000 ohms per volt. Resistance ranges, 0 to 1 megohm. D.C. volts from .15 v. to 1.5 kv. A.C. volts from 7.5 v. to 1.5 kv. A.C. current from 75 ma. to 15 amps. D.C. current from 1.5 ma. to 30 amp. Incorporates safety cut-out. Supplied in perfect working order, complete with leads. **£9/19/6** each. P/P. 3/6.



CRYSTAL MICROPHONE INSERTS. Sensitive, ideal for amplifiers, tape recorders, etc., 4/6 each. P/P. 6d.

12 - VOLT MIDGET ROTARY TRANSFORMERS. Type H.T.11, size 4½ × 2¾in. Output 310/360 volts 30 ma. New and boxed **22/6**. P/P. 1/6.

EX NAVY SOUND-POWERED TELEPHONES. This type requires no batteries to operate and can be fitted in moments to give complete inter-communication between two points. Hand generator calling. Only 45/- each. P/P. 4/6.

MINIATURE H.T. TRANSFORMERS. Input 220/240 v. Output type 1. 220 v. 25 ma. 6.3 v. 1 a. 10/6. P/P. 1/-. Type 2. 220 v. 45 ma. 6.3 v. 1.5 a. 11/6. P/P. 1/3. Midget contact rectifiers, 250 v. 50 ma. **7/6**. P/P. 6d.

METER BARGAINS

50 microamps, 2½in. P.J.M.C.	49/6
500/0/500 microamp, 3½in. F.M.M.C.	49/6
500/0/500 microamp, 2½in. P.J.M.C.	19/6
50/0/50 microamp, 2½in. F.M.M.C.	69/6
50 microamp, 2½in. F.M.M.C.	59/6
30 ma., 2½in. F.M.M.C.	9/6
1 ma., 2½in. F.M.M.C.	25/-
200 ma., 2½in. F.M.M.C.	9/6
1 amp. 2½in. F.M.M.C.	10/6
1.5 amp., 2in. F.M.M.I.	6/6
7.5 amps. 3½in. P.J.M.I.	10/6
300 volt A.C., 2½in. F.M.M.I.	25/-
5/0/5 ma. 2in. F.M.M.C.	12/6
300 ma. 2½in. F.M.M.C.	9/6
15 volt 1½in. F.M.M.C.	10/6
20 volt 2in. F.M.M.C.	8/6
120 volt 3½in. F.M.M.C.	32/6
500 volt AC/DC 2½in. F.M.M.I.	25/-

AMERICAN No. 19 Mk. II TRANSMITTER RECEIVERS. Brand new, complete with all valves, only 65/- each. P/P. 10/-.

VARIAC TRANSFORMERS. Input 230 volts, Output variable from 0/250 volts, 9 amps. £12/10/- each, P/P. 5/-.

WESTON MODEL 722 TESTMETER

An ideal bench or portable instrument. Incorporates 5 A.C. or D.C. volt ranges, 2.5 v. to 1,000 volts, 6 D.C. current ranges 100 microamps. to 500 ma. A.C. current, 500 ma., 1 amp., 5 amps. Resistance, 100 ohms 1 K., 100 K. and 10 megohm. Supplied thoroughly tested in rexine covered carrying case with instructions and leads. **£10/10/-** each. P/P. 4/-.

EDDYSTONE MAINS POWER PACKS

Supplied brand new and unused. Mains input 200/250 volts. Output 175 volts 60 ma. and 12 v. 2.5 a. Double choke and condenser smoothed. 5Z4 rectifier. Housed in grey metal case. Only **32/6** each. P/P. 3/6.

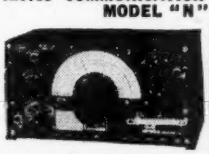
CR.100 SPARES KIT

Complete set of new valves 2 X66, 2 U50, 2 DH63, 2 KT63, 6 KTW61. Also set of resistors, condensors, pots toggle switch and output transformer. Supplied new and boxed **59/6** each. P/P. 4/6.

PORTABLE PRECISION VOLTMETERS

Brand new and boxed instruments by famous manufacturer. Housed in polished teak case. Moving iron movement reading A.C. or D.C. volts on 2 ranges. 0-160 v. and 0-320 v. 8in. mirror scale. Accuracy within 2%. Supplied at a fraction of original case. Only **£5/19/6** each. P/P. 3/6.

R.1155 COMMUNICATION RECEIVERS MODEL "N"



Incorporating the trawler band. Frequency coverage: 200-250 kc/s., 600-1,500 kc/s. 1.5-3 mc/s 3-7.5 mc/s. and 7.5-18 mc/s. Supplied in perfect working order, aerial tested, with illustrated leaflet, **£12/19/6** each. P/P. 7/6. Standard models available but fitted with improved dial drive as above model, **£8/19/6** each. Combined A.C. mains power packs and output stage available. **85/-** each. P/P. 3/6.

SPECIAL OFFER

OF MARCONI SIGNAL GENERATORS TF-517. Frequency coverage 10 to 18 mc/s. and 33 to 58 and 150 to 300 mc/s. Operation 200/250 volts A.C. Supplied in good condition at the ridiculous price of **£12/10/-** each. P/P £1.

PARMEKO TABLE TOP TRANSFORMERS. Input 230 v. 50 cycles. Output 620/550/375/0/375/550/620 volts 250 ma. Also 2-5 volt 3 amp. windings. Size: 6½ × 6½ × 5¼in. Brand new only **45/-** each. P/P. 5/-.

SPECIAL OFFER

NO. 19 SETS MKII

Complete with all valves new condition, only **65/-** each. P/P. 10/-

300ft. COPPER AERIAL WIRE. Ex U.S.A. Brand new. **3/6** reel. P/P. 1/-.

HEAVY DUTY SLIDER RESISTANCES 1 ohm 12 amp. **6/6** each. P/P. 1/-.

AMERICAN TRIPLETT MULTI-RANGE TESTMETERS. 1,000 ohms per volt. Incorporates the following ranges. Volts A.C. 10 to 5 kv. Volts D.C. 10 to 5 kv. Current D.C. 10 ma. to 500 ma. and 2 resistance ranges, 300 ohms and 250 K. ohms. Supplied in working order with leads. **£4/17/6** each. P/P. 2/6.

HEAVY DUTY MAINS ISOLATING TRANSFORMERS. Specifications: Primary 230 volts 3 amps. Secondary 230 volts 3 amps (service rating, OK 5 amps.). Ideal for laboratory or workshop use. Supplied brand new in original transit cases. **£6/10/-** each. P/P. 10/-.

RCA. OUTPUT TRANSFORMERS. Completely potted. Centre-tapped primary, 8,000 ohms. Secondary tapped 3, 7.5, 15 or 600 ohms. Separate feedback winding. 15 watts rating. Suitable for 6L6, EL84, etc., unused, **27/6** each. P/P. 2/-.

EVERSHED AND VIGNOLES MEGGER OHMMETERS

Ideal for all polarity and continuity tests. Supplied brand new with all leads and instructions, only **59/6** each. P/P. 2/-.

CHARGING AND MODEL TRANSFORMERS

1. Pri 200/250 v Sec. 3.5, 9 or 17 v. 1 amp., **9/9**
2. Pri. 200/250 v. sec. 3.5, 9 or 17 v. 2 amp., **14/3**
3. Pri. 200/250 v. Sec. 3.5, 9 or 17 v. 4 amp., **16/6**

Postage 1/6 all types.

L.T. METAL RECTIFIERS. Full wave and bridged. 12 v. 1 amp., **6/3**; 12 v. 2 amp., **9/3**; 12 v. 4 amp., **13/9**., 24 v. 1 amp., **12/6**; 24 v. 4 amp., **22/6**; 36 v. 4 amp., **27/6**. P/P. 1/- all types.

MARCONI TF.144G. STANDARD SIGNAL GENERATORS. 85 kc/s. to 25 mc/s. Reconditioned as new, **£65** each. P/P. £1. Marconi TF-853-854 10 cm. signal generator brand new, **£100**. P/P. **£2**. TF-390 G., from **£12/10/-**.

AMERICAN AUTO TRANSFORMERS. 110/230 volts, 40 watts. Small size, fully shrouded. Ideal for instruments, shavers, etc. Brand new, boxed, **12/6** each. P/P. 1/9.

INSTRUMENT POTENTIOMETERS. 3½in. dia. 10W. rating 5K, 25K, 50K or 100K ohms. New, boxed, **10/6** each. P/P 1/-.

BARGAIN GRAM. MOTORS. Garrard centre-drive motors complete with turntables 200/250 volts A.C. Adjustable mechanically from 0 to 45 r.p.m. Only **22/6** each. P/P. 3/-.

SMOOTHING CHOKE BARGAINS. 10H, 60 ma., **4/6**; 15H, 60 ma., **5/6**; 8H, 100 ma., **8/6**; 9H, 100 ma., **7/6**; 10H, 100 ma., **8/6**; 5H, 200 ma., **5/6**; 20H, 120 ma., **10/6**; 50H, 120 ma., **15/6**; swinging choke 3.6-4.2 H, 250 ma., **10/6**. 3H, 100 ma., **6/6** ; 20H, 50 ma., **7/6**. P/P. 1/- to 2/6.

DYNAMO EXPLODER UNITS. Used for detonating explosive charges. Operation is by hand generator, giving 1,800 volts across output terminals. Ideal also as photo flash. Brand new, only **29/6** each. P/P. 3/-.

MIDGET RECORDER MOTORS. Size 1½ × 1 × 2¾in. Operates from 4.5 to 24 v. D.C. Fitted with reduction gear. New and boxed. **12/6** each. P/P. 1/-.

PARMEKO TRANSFORMERS. Input 230 volts. Output 350/0/350 volts 150 ma. 6.3 v. 4 a. 5 v. 4 a. Brand new, **32/6**. P/P. 3/6. Also 350/310/0/310/350 volts 220 ma. 6.3 v. 5 a., 2 × 6.3 v. 3 a., 2 × 6.3 v. 1 a., 5 v. 3a., potted, **49/6**. P/P. 3/6.

POST OFFICE JUMPER LEADS. Fitted with 2 standard jack plugs, brand new **3/-**. P/P. **6d**. Panel jacks to fit **9d**.

LEACH AERIAL CHANGE-OVER RELAYS

12 v. Double Pole, Ceramic Insulation, New and Boxed, **7/6** each. P/P. 9d.

UNIVERSAL AVOMINOR TEST-METERS.

Small, compact, accurate instrument. Resistance measurements from 0 to 20 k. ohms, D.C. volts from 0 to 500 v. A.C. volts from 0 to 500 v. D.C. current from 0 to 500 ma. Supplied in perfect working order, complete with leather case and leads. **£5/10/-** each. P/P. 2/6.

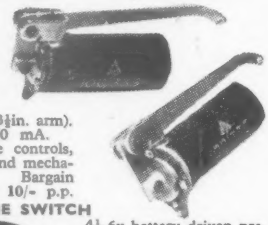
G.W. SMITH & CO (RADIO) LIMITED

Phone: GERRARD 8204/9155
Cables: SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

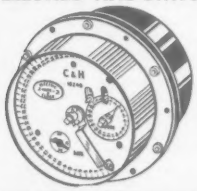
PROOPS BROTHERS LIMITED

ROOM THERMOSTATS
By a famous manufacturer. Voltage 0/250v., maximum current 15A. Temperature control range 50°F to 80°F. Contemporary design in cream hammer finish, complete with wall fixing plate and full installation instructions. Brand new. 15/- Carr. 2/-

12 VOLT SOLENOID
Powerful solenoid with lever mechanism giving a mechanical advantage of approx. 4 : 1 (¾in. travel, = 3¾in. arm). Consumption 350 mA. Ideal for remote controls, model railways and mechanical indicators. Bargain offer. 3 for 10/- p.p.



ELECTRIC TIME SWITCH



4½-6v battery driven precision clock. Current negligible. Can be set to operate at any period between 15 minutes and 44 days. Ideal for automatic "lighting-up" of parked cars etc. and many other uses. In plastic case. 12/6 p.p.

VELODYNE REVERSING MOTOR-GENERATORS TYPE 74

Motor Armature 5A, Field 90 mA. Generator Armature 56v D.C., Field 24v D.C. Size 8 × 3¾in. × ¾in. dia. spindle. £1.15.0. p.p.

EXCLUSIVE OFFER OF
Low-voltage Halogen-Quenched GEIGER-MUELLER TUBES

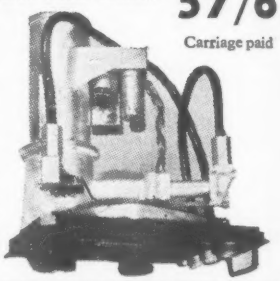
Large contract purchase from famous manufacturer enables us to make an exclusive offer of these highly sensitive gamma counters.
Straight from production, individually tested fully guaranteed at 55/- each.

SPECIFICATION

Effective length 11.8 cm. Standard British 4-pin base.
Background count 90/min.
Plateau: Minimum length 80 v. Slope 5% per 100v.
Working potential: 400-450v.
Current: .001 μA to 1 μA at 100 to 6,000 c/min.
Response: Exceeds 30,000 c/m.
Dead time: 100μ sec. at 6,000 c/m Rise Time 5 to 10μ sec. at 6,000 c/m.
Temperature range—55°C to + 60°C. Gamma Efficiency 1%. Stainless iron electrode.

PORTABLE 70 cm. PRECISION FOR ONLY 57/6
Carriage paid

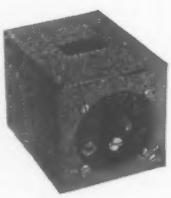
TS184 A/AP



Precision 70 cm. test gear for Mobile Hams, Amateur T.V. and Radio Control enthusiasts. RESONANT CAVITY WAVEMETER calibrated 400-430 Mc/s. Tuning stops adjustable to any 30 Mc/s band within the 400 to 470 Mc/s coverage.
Calibrated scale rack and pinion drive piston input attenuator and alternative fixed coupling loops input provides facilities for use as a signal generator. Plug-in "Telescopic Probe Antenna", and 6J6 detector and Monitor amplifier, 2-600 ohm phone jacks for modulated signals. Panel output terminals for metering 6J6 output current. Power required = 6 volts at 300 mA and 30 volts at 0.5 mA.
24-page booklet supplied with each unit giving comprehensive circuit description, diagrams and suggested modifications etc.

RECEIVERS

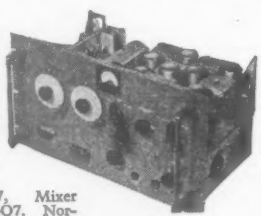
BEACON RECEIVER BCI206A



Covering 200-400 kc/s. Valve line-up: 6K7 RF; 6SA7 frequency changer; 6SK7 I.F. amplifier; 6SQ7 det; 28D7 O/P. This was designed to run on 24/28V D.C. HT/LT. Excellent basis for car radio; size 6 × 5 × 4in. Good working order.
£3.5.0. each, plus 5/- carr.

ARB8 KNOBS. 2¼in skirt. Brand new. **3 for 10/-**, post paid.

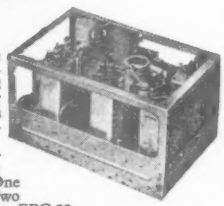
R.1392



95-150 Mc/s (2-3 Metres). 15 Valve Superhet. 1st and 2nd RF. EF54, 1st Local Oscillator SP61, 2 Oscillator Multipliers EF54, 3 IF's EF.39, AGC. 6Q7, Output 6J5, Muting EA.50, Noise Limiter EA.50, BFO.6J7, Mixer EF.54, Detector 6Q7. Normally Crystal Controlled, but can be tuned over 95 to 150 Mc/s. Power supply required = 240-250 volts at 80 mA. 6.3 volts at 4A. Standard Rack Mounting, 19 × 10in. Complete with valves and circuit diagram. Air Tested. £6.19.6. Carriage 10/-

ARR1
13 Valve 60 Mc/s. FM Receiver which can easily be converted to receive B.B.C. transmissions—many supplied by us to B.B.C. engineers for their personal use. 1st and 2nd RF, Mixer, Osc., 1st, 2nd and 3rd IF's all 12SG7's. Limiter and Detector 12H6. 1st AF 12SQ7. Output 12A6. A.F.C. 2 × 12SH7. Magic eye 12U5G. Utilizes Foster Seeley discriminator. Complete with circuit diagram and full conversion instructions. £6.0.0. Carriage 7/6

RECEIVER UNIT EX.1143A



Suitable for conversion to 2 Metres or Wrotham FM transmissions Valve line-up: Four EF.50's; One EL32; Two EF.39's; One EBC.33; One EA.50. Circuit diagram supplied with each unit. Complete with valves. £1.5.0. Carriage 3/6

AN/APN1 TX/RX

Frequency modulated by moving coil transducer—heart of famous W.W. Wobbulator. Freq: Receiver, 400-450 Mc/s. Transmitter 418-462 Mc/s. Easily converted for radio control or 70 cms. Complete with 14 valves, 4-12SH7, 3-12SJ7, 2-12H6, 2-955, 2-9004 and 1-VR150. Contains a host of first class components including relays and close tolerance resistors. Brand new, at less than breakdown price. £1.10.0 Carriage 7/6

'S' BAND PRECISION WAVEMETER

2,900 to 3,150 Mc/s. TEST SET 288 A.M. Ref. 10SB/6161.
Comprising exceptionally rugged silver-plated Wavemeter Type 1665, resiliently mounted and directly tuned by 1¾in. dia. calibrated micrometer with 6¼in. thimble scale. Temperature correction for micrometer attached. Resonance indicated on 100 microamp meter. Equally suitable for laboratory using milliwatt power or, with loose coupling, for high powers. UR21 connecting cable and coupling probe supplied. Brand new in robust moisture-proof case with jacking-off screws and tool.
Price £15, plus £1 packing and carriage.

SIGNAL GENERATOR Type 52A

Complete in transit case with four calibration charts, leads, dummy antenna and circuit. Spec.: Input, 230v 50 c/s. Freq.: 6-52 Mc/s. in Four ranges. Coarse and fine attenuators. Int. and Ext. Mod. Output, 0.5 v to 100 mV. Impedance 70 and 100 ohms. Brand new.
£10.0.0. Carriage 10/-
Complete photostat handbook supplied on request for 4/6 extra.

SIGNAL GENERATOR AND WAVEMETER Type W 1649

In copper lined case. Freq.: Sig. Gen. 140-240 Mc/s. (tolerance 0.5 Mc/s.). Wavemeter 150-235 Mc/s. (tolerance 0.2 Mc/s.). Complete with valves 4 VR91 and 1 VR135, and 5 Mc/s. crystal. Requires 6.3v and 120v power supply. £2.10.0. Carriage 10/-

XUM

The Walk-Around Shop

BARGAIN PRICE TABLE-TOP TRANSMITTER

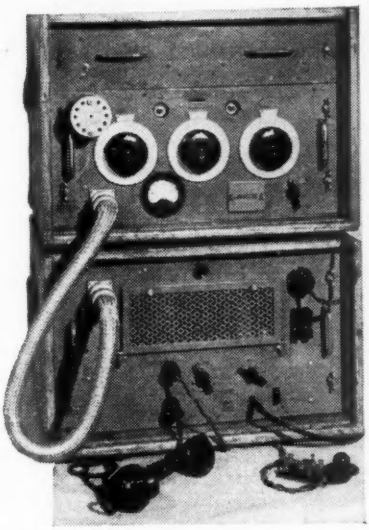
No. 36 SENDER

£12.10.0

complete

Carriage 30/-

GET THIS NEW RIG ON THE AIR IN 5 MINUTES FLAT



The best ham buy for a very long time

A unique opportunity to obtain a complete AIR TESTED 10-60 Mc/s 50 watt transmitting station at an unrepeatable price.
In two units, each housed in a handsome solid oak cabinet with slide out front. Supplied complete with circuit diagram, all connecting cables, hand-set and dummy aerial packed in RF Unit stowage drawer. In excellent condition.
Check this specification against cost.
Frequency coverage: 10-20 Mc/s, 20-40 Mc/s and 40-60 Mc/s by plug-in coils. CW, M.C.W. or R/T Coils supplied cover 10-40 Mc/s only, but third set can easily be made up.
Power Supply: 100-110 volts and 200/250 volts, 40-60 cycles.
Power required, approximately 350 watts.
R.F. Unit: Contains Master Oscillator (with or without crystal control), Frequency Doubler and Power Amplifier. Valves: M.Osc. 807, Intermediate 807, PA2× 807, Voltage regulation 2×S130. Also 2×EM1 magic eye tuning indicators and osglim neon lamp modulation depth indicator. 0-200 m/A PA anode current meter. Size 24½×16½×16½ in. Weight 90 lb.
R.F. Unit: Contains Power Pack, Speech Amplifier and Modulator. 3×FW4/500 rectifiers provide separate H.T. supplies for RF Unit, Bias, and Modulator. Speech Amplifier 6C5G, Modulator 2×6C5G drivers and 2×807 output. Size 24½×16½×14½ in. Weight 120 lb.

INFRA RED VIEWING MONOCULAR

See in the dark with equipment specially developed for night-driving, reconnaissance, sniping etc. Sealed unit with focussing eyepiece and incorporating Caesium cell and push-button operated Zamboni pile. Brand new in superb hide binocular type carrying case.

£1.0.0. p.p.

VIEWING LAMP

Weatherproof car spotlamp providing a powerful source of infra-red rays through easily removable filter. Takes standard 12v. bulb. Swivelling single-point bumper fitting. Brand new. **17.6.** p.p.

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TRANSFORMERS 230-250 volts 50 c/s.
Heater 6.3v, 1.5A, 6/6, plus 1/- carr. **Miniature mains** 230v at 40 mA and 6.3v at 1.5A, **12/6,** plus 1/- carr. **Charging** 9v and 17v at 3A, **15/6,** p.p. **Mains isolating** 250v/220v or 250v/110-0-110v out OR double wound auto 250v in, 110v out, **5/-,** carr. 1/6. **Heavy duty mains changing** (Admiralty Pattern). Primary screened from secondary. Totally enclosed in 7×6×8in. black steel case—terminals inside lid. £1.0.0. p.p.

OUTPUT TRANSFORMERS
Plessey standard miniature output transformers. Ratio 45 : 1 and 55 : 1 **4/6** p.p. Please state ratio required.

FULL-WAVE CHARGING RECTIFIERS—
12v 4A. **14/-** p.p. 24v 1.5A. **12/6** p.p.

LOUDSPEAKERS
Tannoy waterproof external 8 watt unit 7½ ohm impedance. Complete with matching transformer. Brand new, **£1.0.0,** plus **3/6** carr.

HEADPHONES
High resistance balanced armature **£1.0.0.** p.p.
Low resistance balanced armature **8/6** p.p.

MICROPHONES
Acos crystal inserts **4/6** p.p. American throat microphones type T.S.300 including socket 3/- p.p. Aircrew type electro magnetic microphones with switch 2/- p.p. Carbon type in black crackle case **12/6** p.p.

RELAYS
Carpenter type 5C9 polarized 1685 ohms each coil. Current 100-200 μA. **22/6** p.p. Sensitive U.S. type single pole changeover relay. Heavy duty **12/6.** p.p.

R.F. UNIT
Freq: 200 Mc/s. With 3 956 valves. Size 8×3×4in. 15/- p.p.

ELECTROLYTICS
8+8 mfd. 450 vW. **3/6.** 16+16 mfd. 450 vW. **4/3.** 32+32 mfd. 350 vW. **4/6.** 16 mfd. 450 vW. 3/-. All post paid.

MINIATURE I.F. STRIP—9.72 Mc/s.
Complete and unused with circuit, less valves—2 EF92, 3 EF 91, 1 EB 91. **12/-** p.p.

MULTI-RANGE TEST METER
Ranges 0–1.5v, 0.3v; 0–60mA; 0–500 and 0–5000 ohms. Easily read open scale. Simply extended to provide useful pocket fault finder. Size 2½×3½×3½in. Brand new **8/6.** Carr. 1/6.

APN1 TRANSDUCER
The heart of the W.W. TV wobbulator (described on page 252 of June 1956 issue). Brand new **7/6** p.p.

RADIO ALTIMETER
5 mA panel mounting with 3in. dia. 8in. circular scale. Basis for sensitive multimeter. Brand new, boxed. **7/6** p.p.

VALVE BARGAINS. 6K7, 3/- p.p. 6B8G, 3/- p.p. IN21A Silicon crystal 1/6 p.p.

GYRO UNIT AND INVERTER
Can be used as 12v DC motor for models; ideal also for experimentation and gyro demonstration purposes. Inverter: 12v DC input, 3-phase 190 cycle output. Size 4×4×3in. Gyro unit: operates on 3-phase output from inverter. Peak speed 11,400 r.p.m. Caged. Precision made equipment. **12/6** per pair. Carr. 3/-.

ANTENNA RELAY UNIT
Contains 2½in. panel mounting 2 mA meter with separate thermocouple for measuring R.F. and changeover relay. In metal case 3½×4½×3½in. with ceramic stand-off terminals **12/6** p.p.

BOLT CROPPERS
9in. long, extremely powerful **2/6** p.p. Folding type 18in. long—will cut through ¼in. bolt or cable **7/6** p.p.

DYNAMOTOR
Brand new, boxed U.S. Dynamotor. 28v DC input, 330v 170 mA output. Fully smoothed by screened choke/condenser filter unit in base. Dynamotor size 3½×6in. Black crackle finish **17/6** p.p.

CO-AXIAL ADAPTERS
British to American or American to British co-axial adapters. Plug or socket fittings **1/6** p.p.

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Plastic moulded base. Size 3½×1½in. **2/6** p.p.

CONNECTOR BLOCKS
G.E.C. Standard 12 way "chocolate block" connectors. 3 for **6/6** p.p.

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In black plastic case with sighting reflector inside lid and automatic pointer lock. Luminous dial, pointer and sighting lines. Brand new, with instructions **12/6.** Carr. 1/-

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24v Sealed Beam Units. **16/6** p.p.

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Brand new in transit case. 23/- p.p.

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13in. long × 1½in. dia. In wooden case **12/6** p.p.

GROUND POSITION INDICATORS
Contains 24v. motor and follower motors, large quantity of gearing, etc. **35/-** p.p.

THE NEW "TRANSISTOR–8"
COMBINED CAR-RADIO/PORTABLE
PUSH-PULL SUPERHET

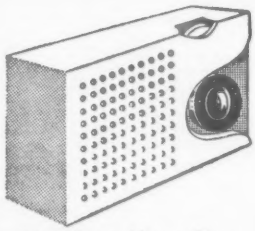
This Portable 8 Transistor Superhet is tunable for both Medium and Long Waves and is comparable in performance to any equivalent Commercial Transistor Set. Simplified construction enables this set to be built easily and quickly into an attractive lightweight cabinet supplied.

TEN STAR FEATURES

★ 8 Specially selected Transistors
★ 250 Milliwatts Output Push Pull
★ Medium and Long Waves
★ Internal Ferrite Rod Aerial
★ 7×4 Elliptical Speaker
★ Drilled Plastic Chassis of 6½ × 9½in.
★ Point to Point wiring and practical layout
★ Economical. Powered by 7½ v. battery
★ Highly sensitive
★ Ideal car radio

Car Radio Conversion Components, 8/- extra.

We can supply all these items including Cabinet for **£11/10/-**. All parts sold separately. Send for circuit diagrams, assembly data, illustrations and instructions, and full shopping list.



Size 5½in. × 2½in. × 2¾in.

MINI–7 POCKET TRANSISTOR PORTABLE
ULTRA SENSITIVE! ECONOMICAL!
HIGHLY SELECTIVE! WELL RECOMMENDED!

MAY BE BUILT FOR ONLY **£10'10'0**

SPECIAL FEATURES

★ 7-selected Transistors
★ Operates from 6 v. Battery
★ Ferrite Rod Aerial
★ Drilled Chassis
★ Practical Layout
★ Medium Waves
★ Long Waves available
★ Attractive Plastic Case

This superhet is superior in performance to most commercial transistor sets and costs less than half the price.

All components as specified can be supplied at an inclusive price of ..... **£10/10/0** P. & P. 2/6.

Send 1/6 for instruction booklet and prices.

HENRY'S RADIO LTD., 5, HARROW RD., EDGWARE RD., W.2 *PAD. 1008/9*

RADIO AND TELEVISION COMPONENTS

ELLIPTICAL LOUDSPEAKERS PM 7in. x 4in. 3/5 ohms. 8,000 line gauss flux density. Bass resonance 100/130, **17/6** each, post 2/-. **MAINS TRANSFORMERS PRI SHIELDED** 195/250 v. SEC 280-0-280 v. 6 3 v. 3.7 amps. 6.3 v. 0.95 amps. With mounted twin fuse holder, tag panel and provision for switch and motor, 27/6, post 3/6. **MAINS TRANSFORMERS** PRI 0-205-225-245 v. SEC 60 v. AUTO 0.010 amps 110 v. 0.020 amps. 5.8 v. 0.6 amps. 4 v. 2 amps., 10/- each, post 2/6. **V.H.F. FM TWIN GANG TUNING CONDENSERS** 0-9.79 pf Ball bearing drive. Size 2½in. x 1½in. x 1½in with t immers, 6/6 each, post 1/-. **ACOS CRYSTAL MICROPHONES** 1½in. Cone 4.7 M/ohms leak (unhoused) Size 2½in. x 2½in. x ½in. Ideal for Tape recorders, Record players, Amplifiers, etc., 10/6 each, post 1/-. **"AMPRETTE" 3 VALVE AMPLIFIER** 4 WATTS TREBLE and BASS, ROBUST & RELIABLE designed for use with modern turnover Crystal pick-ups. £6/10/-. The above Components are only examples of the many lines that we have to offer. Send 3d. stamp today for our very latest lists.

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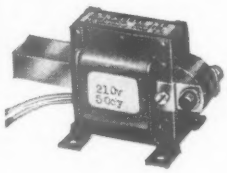
A. C. SOLENOID type SAM/T



Increased Performance
Continuous 14 ozs. at ¾"
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Same dimensions as Type SA.

Larger and smaller sizes available. Greatly increased discounts for quantities. Also Transformers to 7kVA 3 Phase

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★ *Plated*
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FOR USE ON CONVENTIONAL CHASSIS AND PRINTED CIRCUITS

Jason plated Valve Retainers fix into the hollow rivet holes of chassis-mounted valve holders of any thickness, or into two ⅛" holes on printed circuits. Special lengths are supplied for the latter. In 3 sizes: ECF.80, EF.80 and EL.84. ***For immediate delivery***

10/- per sample 100
£3·10·0
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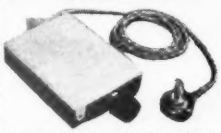
"EAVESDROPPER" THREE TRANSISTOR POCKET RADIO

(No Aerial or Earth required in areas of good signal strength.) Variable tuning on medium waves. Total cost as specified, including Transistors, Transformers Coils, Condensers and Battery, etc., with circuit and plastic case. All items sold separately. Full practical layout diagrams, 70/- post free. With balanced armature earpiece 73/6. With Acos Mike, 83/6. With Min. Hearing Aid, 84/6.

MINI-TWO TWO TRANSISTOR MINIATURE POCKET RADIO



The smallest Transistor set offered on the market. Variable tuning. Drilled chassis, plastic case 3 x 2 x 1in., Miniature Hearing Aid, 2 Transistors and all components including 1½ volt battery, circuits and full practical layout diagrams. All components sold separately. Total cost 44/6 complete.

AC/DC 220/250v. PORTABLE-GRAM AMPLIFIER.

Completely assembled on Baffle Board size 12½ x 4½in. Depth 3in. Containing two Mullard Valves types UL84 and UY85, Elac 7 x 4 Elliptical Speaker, Volume Control, Tone Control. Nothing else to buy, just plug in to Mains and connect your Pick-up to Amplifier.

67/6
Carr 2/6.
Absolute Bargain.

U.S.A. TESTMETER TYPE "834-S"

AC/DC 15—RANGES F.S.D. 1,000 O.P.V.
AC/DC Volts 12/60/300/600v./1,200/6,000v.
Milliamps 1.2/12/60/600 mA. **£6/19/6**
ohms 0-5,000/5 meg.
Complete in wooden carrying case with leads and internal batteries.

WAVE-GUIDE WATTMETER

Type W8921 10 cm. Complete in transit case.
BRAND NEW **£5/10/-**

TEST SET 229

Admiralty type 600 Mc/s. Complete in transit case.
BRAND NEW **£5/10/-**

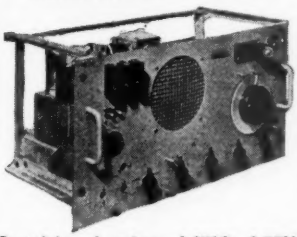
RT10/APS-3

3 Centimetre Radar Unit

Containing 725A Magnetron, 2—723A/B's, 2—6AC7's, 724A, IN23, magnet and pulse trans.
BRAND NEW IN CARTON **£10/10/-**

Sputnik Special

SHORT-WAVE COMMUNICATION RECEIVER
10-60 Mc/s (5-30 Metres)
RECEPTION SET TYPE 208



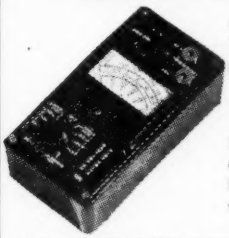
Containing 6 valves, 2-6K8G, 2-EF39, 6Q7G and 6V6G, Metal rectifiers, built-in mains pack and 6 v. Vibrator pack, built-in 6½in. speaker. Muirhead slow motion drive, B.F.O. and R.F. stage. 2 Mc/s I.F. freq. Provision for 'phones and muting and 600 ohm line.

Input 100/250v. A.C. 6v. Vibrapak supplied for battery operation.

£6/19/6
Carr. 15/6.

In new condition and air tested.
BE PREPARED TO LISTEN TO THE SATELLITES

TRIPLETT A.C./D.C. POCKET TEST-METER TYPE 666H



15 ranges
1 000 ohms per volt

In new condition with Prods and Internal battery.

A.C./D.C. 10/50/250/1,000/5,000 volts.
Milliamps 0-10/100/500
Ohms 0-300/250,000.

£5/10/-

CATHODE RAY TUBES

VCR138A with screen	£1	15	0
VCR139A	£1	15	0
VCR139A Mu-metal Screen		5	6
VCR97. Full T.V. picture (carr. 2/-)	£2	0	0
VCR517C. Full T.V. picture	£1	15	0
MU-METAL SCREENS for VCR97 or 517		10	0
VCR97. Slight cut-off. Carr. 2/-		15	0
3BP1. Brand new	£1	10	0

PIRANI HIGH-VACUUM TEST EQUIPMENT

with calibrator and galvo.

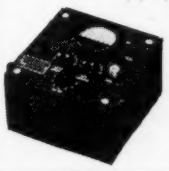
£33/10/-

SEND FOR BOOKLET

EVERSHED WEE-MEGGERS

500 v. new condition, with leather case **£8 19 6**
500 v. brand new, with leather case **£12 10 0**
100 v. new condition, with leather case **£6 0 0**

U.S.A. R.F. WATTMETER TS/87/AP



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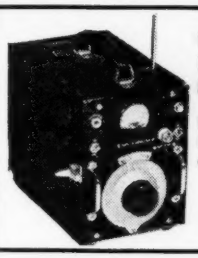

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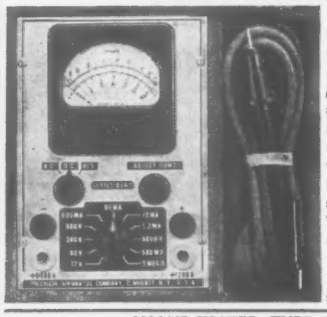

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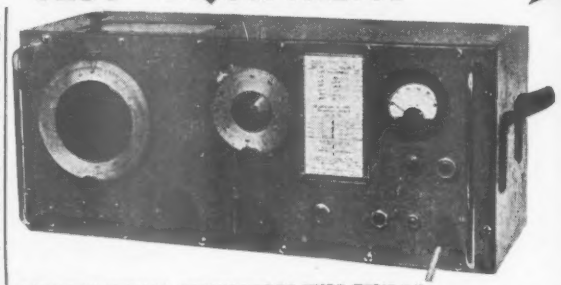

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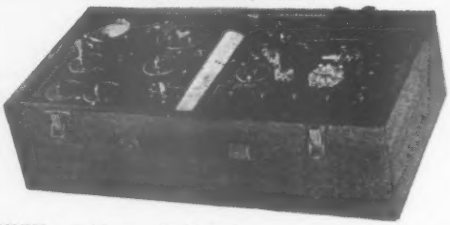

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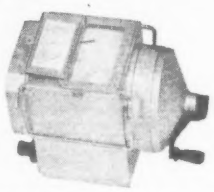

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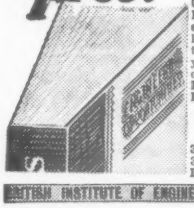

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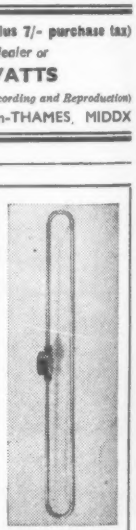

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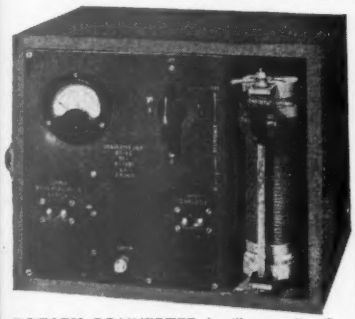

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12 v. 2½ amp. 15/–	24 v. 2½ amp. ...25/–
12 v. 4 amp. 16/6	24 v. 4 amp. 30/–
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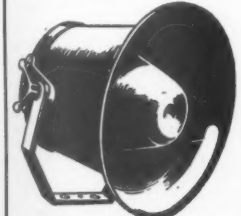

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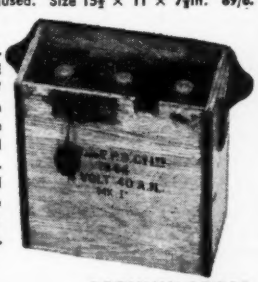

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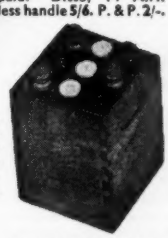

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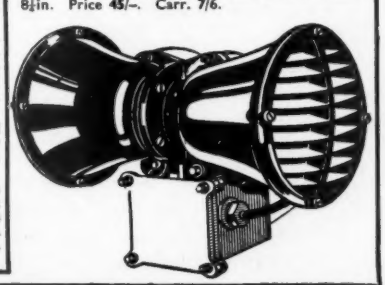

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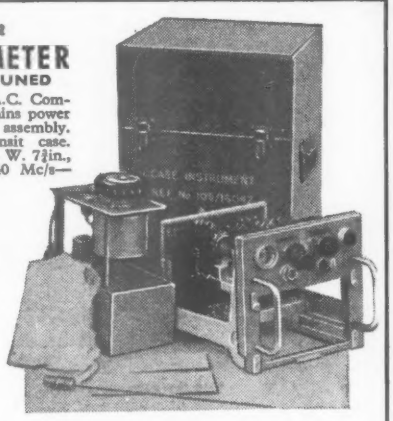

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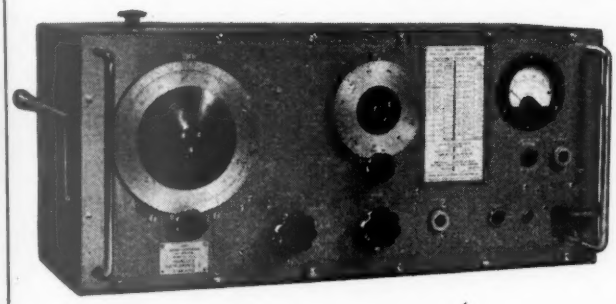

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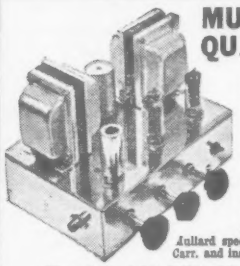

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Complete amplifier wired and tested with quality sectionalised output transformer to Mullard specification (less speaker) **£8.8.0**
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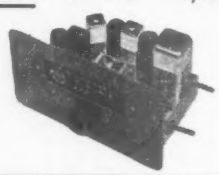

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6SN7	8/6	ECH81	10/6	PY80	9/6
6V6	7/6	ECL80	10/6	PY81	9/6
6X4	7/6	EF41	10/6	PY82	8/6
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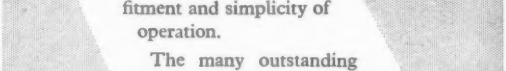

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1 MFD. 275 v. ½in. × 1¼in. W/S. **1/-.** **2 MFD.** 150 v. ¼in. × 1¼in. T. **9d.** **2 MFD.** 275 v. ¼in. × 2in. T. **10d.** **2 MFD.** 500 v. 1in. × 2in. T. **1/-.** **4 MFD.** 150 v. ½in. × 1¼in. T. **9d.** **4 MFD.** 150 v. ¼in. × 1¼in. W. **10d.** **4 MFD.** 150 v. ½in. × 1¼in. W/S. **1/-.** **8 MFD.** 150 v. ½in. × 1¼in. T. **9d.** **8 MFD.** 200 v. 1in. × 1¼in. W/S. **10d.** **8 MFD.** 450 v. ½in. × 1¼in. W/S. **1/11.** **12 MFD.** 450 v. ½in. × 2in. T/S. **2/-.** **16 MFD.** 150 v. ½in. × 1¼in. T/S. **1/-.** **16 MFD.** 150 v. ½in. × 1½in. W/S. **1/-.** **16 MFD.** 275 v. ½in. × 2in. T. **1/3.** **16 MFD.** 350 v. ½in. × 2in. P. **1/6.** **16 MFD.** 350 v. ½in. × 2in. T. **1/9.** **16 MFD.** 450 v. 1in. × 2in. T/S. **2/-.** **20 MFD.** 150 v. ½in. × 1in. T/W. **1/-.** **24 MFD.** 275 v. ½in. × 2in. T/S. **1/6.** **32 MFD.** 275 v. 1in. × 2in. P. **1/6.** **32 MFD.** 275 v. 1in. × 2in. T. **1/9.** **32 MFD.** 350 v. 1in. × 2in. W. **2/-.** **32 MFD.** 450 v. 1½in. × 2in. W/S. **2/6.** **40 MFD.** 150 v. 1in. × 2in. P. **1/-.** **40 MFD.** 150 v. 1in. × 2in. T/S. **1/3.** **40 MFD.** 350 v. 1in. × 2in. P. **2/-.** **40 MFD.** 350 v. 1in. × 2in. T. **2/3.** **40 MFD.** 450 v. 1in. × 3in. W/S. **2/9.** **40 MFD.** 450 v. 1in. × 2in. P. **2/6.** **50 MFD.** 150 v. 1in. × 2in. T. **1/-.** **50 MFD.** 275 v. 1in. × 2in. P/S. **2/-.** **50 MFD.** 350 v. 1in. × 2in. W/S. **2/3.** **50 MFD.** 450 v. 1in. × 3in. P. **2/6.** **64 MFD.** 275 v. 1in. × 3in. P. **2/6.** **64 MFD.** 350 v. 1in. × 3in. P. **3/-.** **100 MFD.** 270 v. 1½in. × 2in. C. **2/3.** **100 MFD.** 275 v. 1½in. × 2in. T/S. **2/6.** **100 MFD.** 275 v. 1in. × 3in. C. **2/6.** **100 MFD.** 300 v. 1in. × 3in. T. **2/9.** **100 MFD.** 350 v. 1½in. × 3in. C/S. **3/-.** **200 MFD.** 250 v. 1½in. × 3in. C/S. **2/-.** **200 MFD.** 275 v. 1½in. × 3in. C. **2/6.** **250 MFD.** 150 v. 1½in. × 3in. P. **1/3.** **8+8 MFD.** 450 v. ¾in. × 1¼in. W/S. **3/-.** **8+8 MFD.** 350 v. 1in. × 2in. T. **2/6.** **8+8 MFD.** 350 v. 1in. × 1½in. T/S. **2/9.** **8+8 MFD.** 500 v. 1½in. × 2in. T. **3/6.** **8+16 MFD.** 275 v. 1in. × 2in. P. **2/9.** **8+16 MFD.** 450 v. 1in. × 2in. T/S. **3/-.** **8+16 MFD.** 450 v. 1in. × 1½in. W/S. **3/6.** **16+16 MFD.** 350 v. 1in. × 2in. C. **3/-.** **16+16 MFD.** 450 v. 1in. × 2in. W/S. **4/-.** **16+32 MFD.** 275 v. 1in. × 2in. T. **2/6.** **20+10 MFD.** 450 v. 1in. × 3in. C. **3/-.** **20+20 MFD.** 150 v. 1in. × 2in. W. **2/-.** **24+24 MFD.** 275 v. 1in. × 2in. T. **2/6.** **24+24 MFD.** 350 v. 1½in. × 2in. T. **3/-.** **32+16 MFD.** 275 v. 1in. × 2in. T. **2/6.** **32+16 MFD.** 350 v. 1½in. × 2in. T. **3/6.** **32+32 MFD.** 150 v. 1in. × 2in. T. **2/-.** **32+32 MFD.** 275 v. 1½in. × 2in. P. **2/9.** **32+32 MFD.** 350 v. 1½in. × 2in. C/S. **4/-.** **40+40 MFD.** 150 v. 1in. × 3in. P. **1/6.** **40+40 MFD.** 150 v. 1in. × 3in. T. **2/-.** **40+40 MFD.** 150 v. 1in. × 2in. W/S. **2/6.** **40+40 MFD.** 275 v. 1½in. × 2in. C. **2/9.** **40+40 MFD.** 450 v. 1½in. × 3in. P. **3/-.** **50+20 MFD.** 150 v. 1in. × 2in. P. **1/9.** **50+50 MFD.** 150 v. 1in. × 2in. T. **2/-.** **50+50 MFD.** 275 v. 1½in. × 2in. P. **2/6.** **50+50 MFD.** 275 v. 1½in. × 3in. C. **2/9.** **50+50 MFD.** 300 v. 1in. × 3in. T. **3/-.** **50+50 MFD.** 300 v. 1½in. × 2in. T. **3/-.** **50+50 MFD.** 350 v. 1½in. × 3in. T. **3/6.** **60+100 MFD.** 275 v. 1½in. × 3in. C. **4/-.** **60+200 MFD.** 275 v. 1½in. × 4½in. C. **4/-.** **60+200 MFD.** 275 v. 1½in. × 3in. C. **4/-.** **60+250 MFD.** 250 v. 1½in. × 3in. C. **4/-.** **60+250 MFD.** 275 v. 1½in. × 4½in. T. **5/6.** **80+50 MFD.** 150 v. 1in. × 2in. W/S. **2/-.** **100+65 MFD.** 250 v. 1½in. × 3in. P. **4/-.** **100+100 MFD.** 275 v. 1½in. × 3in. C. **4/6.** **100+200 MFD.** 250 v. 1½in. × 4½in. C. **4/6.** **100+200 MFD.** 275 v. 1½in. × 4½in. C. **5/6.** **100+200 MFD.** 275 v. 1½in. × 4½in. C. **5/6.** **100+200 MFD.** 350 v. 2in. × 4½in. T. **6/-.** **125+200 MFD.** 275 v. 1½in. × 4½in. C. **5/6.** **200+200 MFD.** 275 v. 1½in. × 4½in. C. **5/6.** **1,000+1,000 MFD.** 6 v. 1in. × 3in. C. **3/-.** **8+8+8 MFD.** 350 v. 1in. × 2in. T. **4/6.** **16+8+4 MFD.** 275 v. 1in. × 2in. P. **2/-.** **16+16+16 MFD.** 275 v. 1in. × 2in. P. **3/-.** **16+32+32 MFD.** 275 v. 1in. × 3in. C. **3/6.** **20+10+10 MFD.** 275 v. 1in. × 2in. P. **3/-.** **20+20+20 MFD.** 150 v. 1in. × 2in. P. **2/-.** **25+25+25 MFD.** 25 v. 1in. × 2in. T/S. **1/6.** **30+25+20 MFD.** 150 v. 1in. × 2in. C/S. **2/-.** **32+32+2 MFD.** 275 v. 1½in. × 2in. C. **2/6.** **32+32+8 MFD.** 275 v. 1in. × 3in. C. **3/-.** **32+32+8 MFD.** 350 v. 1½in. × 2in. C. **3/6.** **32+24+24 MFD.** 350 v. 1½in. × 3in. C. **4/-.** **40+20+10 MFD.** 350 v. 1in. × 3in. P. **3/6.** **40+20+70 MFD.** 150 v. 1in. × 2in. T/S. **2/6.** **40+20+20 MFD.** 450 v. 1½in. × 3in. T/S. **4/6.** **40+30+20 MFD.** 275 v. 1½in. × 3in. P. **4/6.** **40+40+20 MFD.** 275 v. 1in. × 3in. 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2 MFD., 6 MFD., 8 MFD., 10 MFD. ¼in. × 7/16in. 3 v or 6 v. **16 MFD.** and **30 MFD.** ⅜in. × ½in. **2/9 each.**

MINIATURE BIAS CONDENSERS

25 MFD. 25 v. **50 MFD.** 12 v. **50 MFD.** 25 v. ⅜in. × ½in. **1/6 each.**

25 MFD. 50 v. ½in. × 1¼in. **1/9 each.**

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½in. × ¼in. 100 v. working.

.005 MFD. .0022 MFD. .002 MFD., .001 MFD. **8d. each.**
.01 MFD., .02 MFD. Price **9d. each.** .04 MFD. **10d. each.**

MINIATURE MICA CONDENSERS **6d. EACH**

350 v. wkg. 47 pF., 50 pF., 100 pF., **300 pF., 350 pF., 500 pF., 750 pF., 1,000 pF.**

SILVER MICA CONDENSERS. **4d. EACH**

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DISC CERAMIC CONDENSERS 500 v. Wkg.

.001 MFD., .0025 MFD., .002 MFD., .003 MFD., .005 MFD. **6d.** each. .01 MFD. **9d.** each.

FEED THROUGH CONDENSERS. **6d. EACH**

100 pF., 1,000 pF.

HIGH VOLTAGE SILVER MICAS

100 pF., 5 kV. working. 300 pF., 8 kV. Test. **9d. each.**

VARIABLE GANG-CONDENSERS

Twin Gang. 20 pF. Ideal for F.M. 2in. × 1⅛in. × 1in., **2/- each.**
Twin Gang. .0005 MFD. 2⅛in. × 2in. × 1⅛in. Spindle ¼in., **4/- each.**
Min. Twin Gang. .0005 MFD. 2⅛in. × 1⅛in. × 1⅛in. Spindle ¼in., **5/6 each.**
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T.C.C. **.02 MFD.** 350 v.w. **8d.** Dubilier. **.05 MFD.** 350 v.w. **8d.** Hunts. **.05 MFD.** 500 v.w. **9d.** Dubilier. **.1 MFD.** 150 v. **4d.** **.1 MFD.** 500 v.w. **9d.**

WIRE WOUND RESISTORS

5 watt size ⅜in. × 1¼in. **10d. each**

7 Ω., 7.5 Ω., 8 Ω., 10 Ω., 12 Ω., 15 Ω., 20 Ω., 22 Ω., 24 Ω., 27 Ω., 30 Ω., 33 Ω., 34 Ω., 36 Ω., 39 Ω., 41 Ω., 45 Ω., 45 Ω., 47 Ω., 50 Ω., 51 Ω., 52 Ω., 54 Ω., 55 Ω., 56 Ω., 60 Ω., 64 Ω., 66 Ω., 67 Ω., 68 Ω., 70 Ω., 75 Ω., 80 Ω., 82 Ω., 110 Ω., 136 Ω., 150 Ω., 160 Ω., 170 Ω., 180 Ω., 200 Ω., 220 Ω., 250 Ω., 270 Ω., 300 Ω., 320 Ω., 330 Ω., 375 Ω., 400 Ω., 430 Ω., 470 Ω., 500 Ω., 560 Ω., 600 Ω., 620 Ω., 680 Ω., 800 Ω., 820 Ω., 940 Ω., 1 K., 1.1 K., 1.3 K., 1.4 K., 1.6 K., 1.7 K., 1.8 K., 2 K., 2.2 K., 2.4 K., 2.5 K., 2.7 K., 3.3 K., 4.5 K., 4.7 K., 5 K., 5.2 K., 5.6 K., 5.9 K., 6 K., 6.2 K., 6.5 K., 6.8 K., 7 K., 8.5 K., 9 K., 10 K.

6 watt size. ⅝in. × 1¾in. **1/- each.**

47 Ω., 85 Ω., 100 Ω., 200 Ω., 250 Ω., 260 Ω., 300 Ω., 350 Ω., 400 Ω., 470 Ω., 500 Ω., 560 Ω., 680 Ω., 1 K., 1.6 K., 1.8 K., 1.9 K., 2 K., 2.7 K., 3 K., 3.3 K., 4.3 K., 4.7 K., 5.1 K., 5.6 K., 6.2 K., 6.4 K., 6.8 K., 11 K., 13 K., 14.5 K.

7 watt size. ⅝in. × 1¾in. **1/- each.**

10 Ω., 12 Ω., 30 Ω., 22 Ω., 29 Ω., 33 Ω., 46 Ω., 50 Ω., 55 Ω., 57 Ω., 60 Ω., 120 Ω., 220 Ω., 270 Ω., 330 Ω., 390 Ω., 470 Ω., 600 Ω., 620 Ω., 680 Ω., 800 Ω., 820 Ω., 1 K., 1.6 K., 1.8 K., 3 K., 3.3 K., 3.7 K., 3.8 K., 4.3 K., 4.7 K., 5 K., 7 K., 11 K., 12.5 K., 13 K., 14 K., 15 K., 17 K.

HIGH STABILITY RESISTORS

1½ watt, ½ watt, ¼ watt, 1 watt, 1%, 2%, 5%. Price 1% **10d.** 2% **8d.** 5% **6d.** Please send lists first.

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⅛, ¼, ½ watt **3d. each.** 5% **4d. each.** 1 watt **4d. each.** 2 and 3 watts **5d. each.** Please send lists first.

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34 Mc/s. I.F. Transformers. Size 1½ × ⅞ × 2½. **1/6.**
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Less Switch. Dia. 1in., 2¼in. spindles 5 K., 10 K., 25 K., 50 K., 100 K., 250 K., 500 K., 1 Meg., 2 Meg., **2/6 each.**
With D.P. Switch Dia. 1in., 2¼in. spindles, 5 K., 10 K., 25 K., 50 K., 100 K., 250 K., 500 K., 1 Meg., 2 Meg., **4/6 each.**

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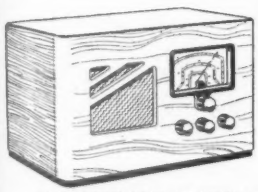


HOME RADIO 79/6

AC/DC. Universal mains. 5 valves octal superhet. 3 w/band receiver, can be adapted to Gram P.U. In attractive wood cabinet. 18½in. x 11½in. x 8½in. Ins./carr. 7/6.

ATTRACTIVE EXTENSION SPEAKER, 29/9

Complete, fitted with 8in. P.M. speaker "W.B." or "GOODMANS" of the highest quality. Standard matching to any receiver (3-5 ohms). Flex and switch included. Money refunded if not completely satisfied. Ins./carr. 3/-.

TELEPHONE SETS, 7/9.

Ex-W.D. Wireless remote control unit, E.Mk.II. New condition. Morse tapper, switched, jack plugs, etc., less phone. P. & P. 3/6.

TRANSFORMERS

MAINS POWER TRANS 350-0-350 v., 9/9. 250 mA. 6 v. heater at 5 amp., 4 v. at 5 amp. 4 v. centre tapped. Drop through type. Prim. 200-250 v. (4½in. x 5in. x 5in.). Post 3/9.
MAINS TRANS. 350-0-350 v. 80 mA. 4 v. 4 v. heaters. 200-250 v. Prim Post 3/9
MAINS TRANS. 350-0-350 v. 80 mA. 12 v. 4 v heaters, 200-250 v. Prim. Post 2/9.
MAINS TRANS. 280-0-280 v. 80 mA. 6 v. 4 v. 200-250 v. Prim. Post 5/9.
O.P. TRANS., 1/3. Std. size 2-5 ohms. Post 1/-. 20 for £1. Post 5/6.

T.V. AERIALS, 25/6.

For all I.T.A. channels. For outdoor or loft. 3 elements Famous manufacturer. Sold at half the normal cost. P & P. 2/6.

AERIALS. 15/9. B.B.C Indoor type. Folded dipole with 12ft. of Co-Ax. Cable fitted. Post 1/9.

RECTANGULAR T.V. TUBES

(USED)

As supplied for past 8 years.

14" £5.10.0
17" £7.10.0
Ins. Carr. 15/6

Set tested. Reclaimed. Shown working to personal shoppers.

SPECIAL OFFER of 14in., 15in., 16in. round T.V. tubes at £5. Convert your 9in. 10in., 12in. to these sizes. Full instructions in our FREE catalogue.
12in. TV TUBES, £6. 3 months' guarantee on all round tubes. Ins./carr 15/6.
TUBES WITH BURNS, £1, incl. carr. Perfect picture. Get one now while stocks last. Enquiries invited.

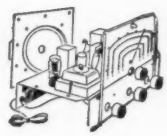
SELF FEED SOLDERING TOOL, 19/6.

6-12 volt. 110-125 volt. Made for the American market. Car battery or mains. Export quality. Complete in light carrying case. Reel of solder and spare parts. Post 2/9. 200-240 volt adaptor 10/- extra.

CO-AX. CABLE, 6d. yard. Good quality. Cut to any length. 1/6 post on 20 yards. 45/- per 100 yards. Post 3/6.

INSULATION TAPE, 1/6.
Finest quality 75ft. x ½in. wide. Post 9d.

SUPER CHASSIS, 99/6



5-valve s/het chassis, including 8in. speaker 4 Control knobs (Tone volume, Tuning, w/change sw.), 4 w/band with position for gram. P.U. and extension speaker. A.C. Ins./carr. 5/6.

(BARGAINS.)
CONSTRUCTOR T.V. CHASSIS.

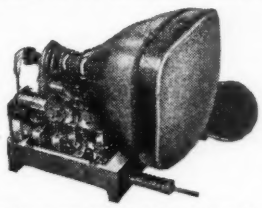
SOUND AND VISION STRIP, 10/6. S/het. Complete vision strip, less valves. Free drawing. P. & P. 2/6.

TIME BASE, 4/9. Including scanning coil, focus unit, etc., less valves. P. & P. 2/6.

POWER PACK AND AMPLIFIER, 29/6. R.F. E.H.T. Not tested. Amplifier stage 6V6 with O.P. trans. 3 ohms matching. Smoothed H.T. 350 volt at 250 mA., 6.3 v. at 5 amp., 22 v. at 3 amp., 6.3 v. at 4 amp. and 4 volt centre tapped. Less valves. Drawings free. Size: 14½in. x 8in. x 7in. Ins./carr. 5/6.

POWER PACK AND AMPLIFIER, 19/6. Output stage PEN 45 O.P. trans. choke. Smoothed H.T. 325 volt at 250 mA., 4 v. at 5 amp., 6.3 v. at 5 amp., 4 v. at 5amp. centre tapped, valve base for rectifier. Octal or 4 pin. Output is taken from standard plugs. Less valves. Ins. and carr. 5/6.

17" T.V. CHASSIS. TUBE & SPEAKER, £19.19.6.



Latest improved circuits, higher E.H.T. (brilliant picture). Improved sensitivity (for greater range). Chassis easily adapted to any cabinet. 17in. Rectangular tube on adapted chassis. Channels 1-5 less valve. With all channel TURRET TUNER, 50/- extra. Chassis size: 14½in. x 11½in. deep. With 5 valves, 6SN7GT, 6V6, EV51, 2—6D2's. £21/19/6. With all valves including 6L18. EL38 7—6F1's. £25/19/6. 12 months' guarantee on tube, 3 months on valves and chassis. State B.B.C. channel and I.T.A. if TURRET TUNER ordered. Ins./carr. 25/6.

14" T.V. CHASSIS TUBE & SPEAKER, £13.19.6.

As above with 14in. round tube. Guaranteed 3 months. With 5 valves, £15/19/6. With all valves, £19/19/6. All channel TURRET TUNER, 50/- extra Ins./carr 25/6.

HEADPHONES, 1/9

Single earphone and band C.L.R. Ideal for crystal sets, extension on radio, etc., Post 1/3.

T.V. CHASSIS. 25/6. Ideal only for spares. Although this chassis has a wealth of components, it is considered uneconomical to attempt rebuilding. This chassis is in three separate units, Power Pack, Time Base, and S/Vision strip. I.F.'s 16-19.5 Mc/s. Drawings FREE. Ins. and Carr. 10/6.

T.V. MASKS

T.V. MASKS, 3/9. 12" New White rubber. Post 1/9.

T.V. MASKS, 14/9. 17" Brand New in GREY, WHITE & Halo Lighting. Post 2/-.

GANG CONDENSERS 1/6. 2 & 3 Gangs .0005. P. & P. 1/3.

8" P.M SPEAKER, 8/9.

Ideal for kitchen and bedroom extension. Let the lady of the house listen to that Radio or TV programme. Complete with O.P. trans., 10/-. P. & P. 2/9.

POPULAR RADIO OR RADIOGRAM CHASSIS, 30/6.

3 w/band and gram. 5 valve s/het. International octal. Ideal table gram, but still giving high quality output. 4 knob control. 8in. P.M. Speaker, 7/9 extra. Set of knobs, 2/-. Chassis size: 12in. x 6in. x 9in. Less valves. Ins./carr. 4/6.

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2C22	2/9	12K7	8/9	ECH42	8/9	EF92	3/9
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6B8	3/9	451U	10/9	EF91	7/9	KTW61	5/9
6F12	5/9	77	1/9	EF37	4/9	PEN45	6/9
6H6M	1/9	CV188	1/9	ECH81	8/9	RL37	1/9
6P28	10/9	DF66	5/9	EF50	2/9	SP61	2/9
6SG7	2/9	EB34	1/9	EL32	4/9	TT11	4/9
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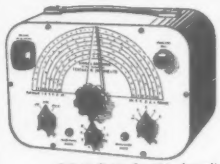
SIGNAL GENERATOR



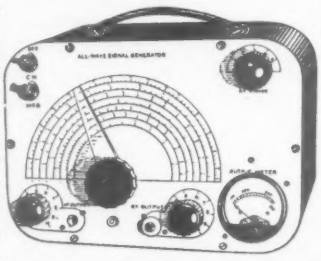
Coverage 100 Kc/s.-100 Mc/s. on fundamentals and 100 Mc/s to 200 Mc/s. on harmonics. Metal case 10in. × 6½in. × 5½in., grey hammer finish. Incorporating three miniature valves and Metal Rectifier. A.C. Mains 200/250 v. Internal Modulation of 400 c.p.s. to a depth of 30%; Modulated or unmodulated R.F., output continuously variable 100 millivolts, C.W. and mod. switch, variable A.F. output. Incorporating magic-eye as output indicator. Accuracy plus or minus 2%.

£6/19/6 Or 25/- deposit and 6 monthly payments of 21/6. Post & Packing 5/- extra.

£4/19/6

Or 25/- deposit and 4 monthly payments 21/6. P. & P. 5/- extra. Coverage 120 Kc/s.-230 Kc/s., 300 Kc/s.-900 Kc/s., 900 Kc/s.-2.75 Mc/s., 2.75 Mc/s.-8.5 Mc/s., 8 Mc/s.-28 Mc/s., 16 Mc/s.-56 Mc/s., 24 Mc/s.-84 Mc/s. Metal case 10in. × 6½in. × 4½in. Size of scale, 6½in. × 3½in. 2 valves and rectifier A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated R.F., output continuously variable 100 milli-volts, C.W. and mod-switch variable A.F. output and moving coil output meter. Grey hammer finish case and white panel. Accuracy plus or minus 2%.

SIGNAL GENERATOR



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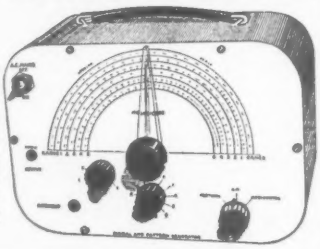
Coverage 7.6 Mc/s.-210 Mc/s. in five bands, all on fundamentals, slow motion tuning audio output, 8 vertical and horizontal bars, logging scale. In grey hammer finished case with carrying handle. Accuracy ± 1%. A.C. mains 200-250 v.



PORTABLE AMPLIFIER

Size 6½in. long, 5in. high, 2½in. deep. Will suit any type of crystal pick-up. Output approx. 2 watts. Incorporating ECC.83 double triode, Cossor 142PT output pentode and contact-cooled rectifier. Fully isolated mains transformer **49/6** Plus P. & P. 3/6 for 230/250 A.C. mains. Base, treble and volume controls.

5" SPEAKER WITH O.P. TRANSFORMER

purchased with the above 18/6. Plus P. & P. 1/6.

COLLARO MIXER 4-SPEED AUTOMATIC CHANGER

Model 457. Type "O" Pick-up, size 12in. × 13½in. Minimum clearance above baseboard 5in., below 2½in. 10 records. A.C. mains 200/250 v. Turnover crystal head. BRAND NEW. Fully guaranteed (suitable for use with above amplifier). 25/- deposit plus P. & P. 5/- and 7 monthly payments of 25/-.

Cash **£8/19/6** Plus P. & P. 5/-.

AC/DC POCKET MULTI-METER KIT

Comprising 2in. moving coil meter, scale calibrated in A.C./D.C. volts, ohms, and milli-amps. Voltage range A.C./D.C. 0-50, 0-100, 0-250, 0-500. Milli-amps, 0-10, 0-100. Ohms range, 0-10,000. Front panel, range switch, wire-wound pot (for ohms zero setting), toggle switch, resistors and meter rectifier. Basic movement 2mA. In grey hammer-finish case.

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Point to point wiring diagram 1/- free with kit.

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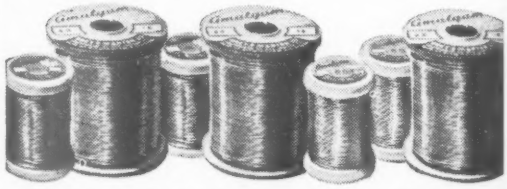

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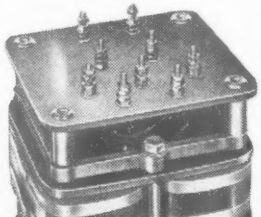

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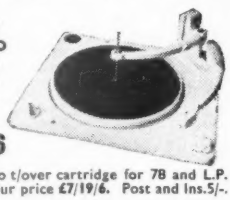

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With Studio t/over cartridge for 78 and L.P. records. Our price **£7/19/6.** Post and Ins.5/-.

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THE LATEST COLLARO 4-SPEED SINGLE RECORD PLAYER. 4/564 with STUDIO t/over CRYSTAL PICK-UP. Our price **£6/19/6.** Plus 5/- carr. and ins. Plays 78 and L.P. records

THE COLLARO "JUNIOR" 4-speed record player, complete with Collaro Crystal pick-up. Our price **£4/10/-.** 4/- post and ins. Gram Motor and Turntable **£3/2/6.** Crystal Pick-up only **£1/12/6.** Carr. and ins. 2/6 extra.

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THE NEW B.S.R. TU9. 4 speed player with FulFi crystal t/over p/up. Amazing value **£4/12/6.** Post and ins. 3/6.

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Featherweight pick-up with H.G.P.59/1 t/over. cartridge and p/up rest. **32/6** plus post and ins.

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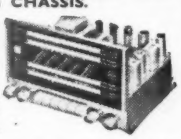
PRICE **£29.8.0**
(Plus 7/6 carriage and insurance).
H.P. Dep. £14/14/- and 12 monthly payments of **£1/6/1.**



A 9 valve chassis using the latest MULLARD valves. VHF/FM, SHORT, MEDIUM and LONG WAVES. Push-Pull output, with negative feedback, 6 watts peak output. "Piano Key" Selectors and separate Bass and Treble controls. "Magic Eye" Tuning indicator. Dimensions: 13in. x 9½in. x 8in. high. Dial size 11¾in. x 5¾in.

THE DULCI 4 watt 4 valve amplifier with control panel for remote mounting. Separate bass and treble control selector switch. Matched to radio, L.P. and 78 records. Price **£9.9.0**
Plus 5/6 post.

THE POPULAR MULLARD 5/10 P/PULL AMPLIFIER.

Freq. response from 10-20,000 CPS suitable with any crystal p/up. Completely assembled. Exceptional value **£12/10/-.** (Plus 10/- post and ins.).
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Our Price 32/6 plus 2/6 post and ins. 4½in. Plessey P.M. Speaker 3 ohms impedance. 14/9 post 1/6.

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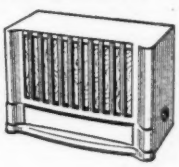

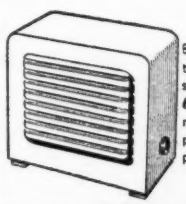

9in. speaker in beautiful design cabinet, **63/-.** Both cabinets finished in pastel green. 4/6 post and ins.

READY BUILT 2 VALVE PRINTED CIRCUIT, 3 WATT GRAM AMPLIFIER using 2 Mullard valves, including output transformer and mains dropper. Astounding value at **£2/12/6.** Post and ins. 2/6.

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8 valve AM/FM Chassis with printed circuit FM tuner section. Illuminated dial. Coverage 1,000-2,000 metres, 200-550m., 88-100 m/cs. Dimensions 13" x 9" x 6".
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F. ROD AERIALS. Bottom sections 4 feet Copper Plated. Can be used to form Beam Antenna or complete Aerial Masts. 2/3 each or 6 for 12/-. Please add carr.

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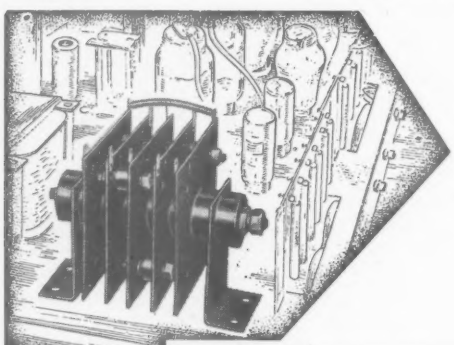

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RATINGS FOR INDUCTIVE AND RESISTIVE LOADS

	TYPE	A.C. INPUT max. r.m.s volts (per phase)	D.C. OUTPUT max. voltage volts	D.C. OUTPUT max. current amperes	OVERALL LENGTH inches
SINGLE-PHASE	GA31-A	140	125	2·0 at 40°C	3½
	GA41-A	53	47	2·0 at 60°C	3½
	GA51-A	210	187	2·0 at 40°C	3½
	GA61-A	106	94	2·0 at 60°C	3½
	GA52-A	340	303	2·0 at 40°C	5
	GA62-A	170	151	2·0 at 60°C	5
	GA53-A	510	455	2·0 at 40°C	6½
	GA63-A	254	227	2·0 at 60°C	6½
THREE-PHASE	GB31-A	140	188	3·0 at 35°C	4½
	GB41-A	53	71	3·0 at 55°C	4½
	GB51-A	210	283	3·0 at 35°C	4½
	GB61-A	106	143	3·0 at 55°C	4½
	GB52-A	340	458	3·0 at 35°C	6½
	GB62-A	170	229	3·0 at 55°C	6½

BRITISH THOMSON-HOUSTON

THE BRITISH THOMSON-HOUSTON CO., LTD., RUGBY ENGLAND
an A.E.I. Company A.5184

POTentiometer LOCKS

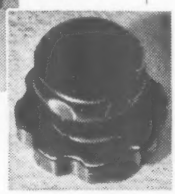
KNOB LOCK

The ideal method of locking panel mounted controls. Positive guard against vibration, etc.

PRE-SET CONTROL LOCK

TYPE P.K.2

Very attractive appearance for panel mounting.



TYPE C.H.2

These units are designed to lock the spindles of pre-set potentiometers or trimmers without rotational or lateral displacement of shaft. Will accept wide range of panel thicknesses. Send for leaflet A.1.

This development of our popular pre-set control lock is finished in black plastic and embodies control knob and instantaneous finger-tip locking knob. Send for List No. A.6.

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7½ amp. D.C. M.I. 3½in. Rnd. Pr.	12/6
1 mA. M.C. 2½in. Fl. Rnd.	22/6
200 mA. M.C. 2½in. Fl. Rnd.....	9/6
25 v. D.C. M.C. 2in. Fl. Rnd.	7/6
300 v. A.C. M.C. 2½in. Fl. Rnd.	22/6

Dual range pocket volt meter 0–25 and 0–250 v., in wallet. **12/6.**
Ex equip. 500 microamp. 2in. M/c. scaled. 0–15 and 0–600 v. **14/6.**
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4,000 ohms, imported, new	15/–
2,000 ohms, "Ivalek," Brit. New	12/6
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Throat, carbon, U.S.A.	3/6
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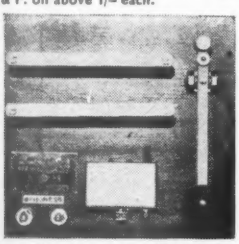
Type 48, ex oxy. mask.....	3/6

P. & P. on above 1/– each.



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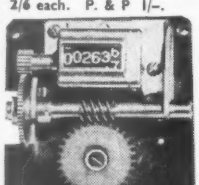

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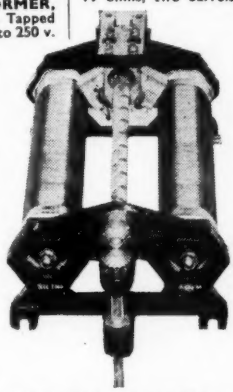

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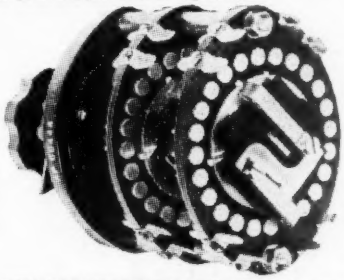

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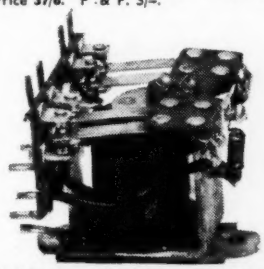

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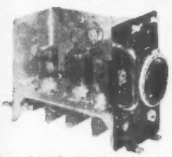

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RCAF AMPLIFIER UNIT. 12 v. input Vibrator Pack. 250 v. output OZ4. Microphone transformer into a 6K6 GT output valve with negative feed back, size 8 × 5½ × 8½in. Brand new, **30/-** each. P. & P 3/-.

500 MICROAMPS METER. 2in. circular calibrated 0–15 and 0–600 volts, resistance 500 ohms. New and unused **17/6.** P. & P. 2/6.

COMMUNICATION RECEIVER RA 1B. Covers 150 kc/s-15 Mc/s. in 6 bands, 12 or 24 operation. S.A.E. for details.

LUMINOUS MAGNETIC MARCHING COMPASS. Pocket size. Brand new with instructions. ONLY **12/6.** P & P. 1/-

WIRELESS SET No. 19 MK. II. As described and recommended for amateur use in April and May issues of "Practical Wireless," this famous Trans./Receiver incorporates "A" set—TX/RX covering 2-8 Mc/s (37.5-150 metres). "B" set V.H.F. TX/RX covering 230-240 Mc/s (1.2-1.3 metres) and intercomm. amplifier. Complete with 15 valves, 500 microamps check and tuning meter, circuits and instruction book (American manufacture). In magnificent condition. **60/-,** carr 10/-. Attachments for above: Variometers **20/-** Headphone and Microphone assembly **13/6.** Morse key assembly **4/6,** 12ft. aerial **7/6.**

GOODMAN OUTPUT TRANSFORMERS. Impedance 5,000 ohms to 3 ohms, 3 watt, suitable for 6V6's, 6BW6, etc., **4/6** each. Post 1/-.

WESTON 1 AMP. H.F. METERS. 2in. circular. Brand new, **5/6.** P. & P. 1/-.

DIPOLE AERIAL No. 4A. 52 feet hard drawn 7/22 copper wire with centre insulator, fitted with feeder sockets. Both ends have 3 link insulators and slotted wire adaptors. Brand new, price **9/-.** P. & P. 2/-.

ARMOUR RECORDING WIRE. U.S.A. top quality on original reels, length 3,700 yds. **10/-.** P. & P. 1/6.

BENDIX RECEIVER RA 10. A 4 wave-band superhet covering 150 kc/s-10 Mc/s. Valves 6SK7 1st R.F., 6K8 Mixer, 6SK7 1st and 2nd I.F., 6R7 2nd Det., 6C5 B.F.O., 6K6 output. Size 6½in. x 15½in. Easily converted to mains operation as described on page 453 of the September "Practical Wirele.s." **£5/10/-,** carr. 7/6.

RELAYS. 6,500 ohms and 3,500 ohms. **8/-** pair, post paid.

HIGH RESISTANCE HEADPHONES. Type No. 2 4,000 ohms. Brand new **11/6** each. P. & P. 1/6.

INDICATOR UNIT SLC No. 5. Ideal for conversion into an Oscilloscope using a 139A or ACR 10 tube. Unit consists of 2-VR65's, 1-VR66, various resistors, condensers and pots. Size 11 × 6 × 3in. Brand new, complete with modification circuit (less tube), **20/-.** P. & P. 3/-.

COMMUNICATION RECEIVER R1155

This magnificent 10 valve, 5 waveband receiver gives worldwide reception over a coverage of 75–200 kc/s., 200–500 kc/s., 600–1,500 kc/s., 3–7.5 Mc/s., 7.5–18.5 Mc/s. (4,000-13.5 metres), incorporating Medium, Long and Shortwave bands. Requires 250 v. and 6 v. Fully tested and dispatched in full working order complete with super slow motion drive, circuit and instruction book. OUR PRICE ONLY **£8/10/-.** Carr. 10/-.

WALKIE/TALKIE SET

60/-

P. & P. 4/-.

Consisting of transreceiver covering 7.4–9 Mc/s. range approx. 5 miles, complete with five valves, headphones, microphone, junction box and 6ft. telescopic aerial. Set only requires 120 v. and 3 v. dry battery. These magnificent Walkie/Talkie sets (as used by H.M. FORCES) are ideal for any application and can be operated with ease by young and old alike.

TWO FOR **£6** POST FREE.

SATELLITE RECEIVER

Receive Radio Signals being transmitted by the U.S. Satellite on approx. 108 Mc. This Receiver is AM and Crystal Control on six pre-set frequencies in the 108.3 to 110.3 Mc. range. Provides audio and band pass filter output of 90 and 150 cycles for aircraft instrument landing, for which it was originally used. Complete with ten valves: 1/12AH7, 2/12SG7 2/12SR7, 1/12SQ7, 3/717, 1/12A6. Crystals: Voltage required: 12 or 24 VDC and 220 VDC 80 MA. Size: 13¾in. × 5in. × 7in. Also can be converted to FM Receiver 80 to 108 Mc. Price **£4,** carriage 7/6.

WHEATSTONE BRIDGE

Consisting of four stud switches: 0–10 ohms, 0–100 ohms O-INF. Galvanometer centre zero F.S.D. 2.5mA. Ranges easily extended. Housed in oak cabinet 16 × 7½ × 6in. Complete with instructions, **40/-.**

P. & P. 4/-.

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Install your own intercomm.!!! with this brand new kit consisting of 2 "press to talk" hand telephones, long life battery, 100ft. of cable and simple wiring details. Ideal for garage, office, workshop, factory, farm, camping, and home. Will give endless hours of pleasure and has proved reliable under all conditions. Complete kit sent for only **25/-.** P. & P. 3/6.

POCKET VOLT TEST METER

Two D.C. ranges 0–250 v. and 0–15 v. Complete with test prods. Brand new. Very limited quantity. Only **10/6.** P. & P. 1/6.

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Ideal for night viewing, etc. Complete with push-button power unit and focus lenses. Brand new in beautiful leather carrying case. Originally cost Govt. £40. OUR PRICE **25/-.** P. & P. 3/6.

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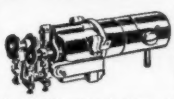

24 v. D.C. with built-in precision gearbox. No. 1 drive 24 R.P.M. No. 2 drive 6 R.P.M. On 12 v. No. 1 drive 16 R.P.M. No 2 drive 4 R.P.M. Overall size of motor and gearbox 7½ × 3¼ × 3in., weight 11b. 14 oz., Brand new. **17/6.** P. & P. 3/-.

RCA MAINS TRANSFORMERS. Input 110-240 v. Output 245-0-345 at 150 mA. 6.4 v. at 4.5 amps., and 5 v. at 2 amps. Brand new, fully shrouded. Write now. Only **35/-.** P. & P. 3/-.

LEAD ACID ACCUMULATORS (unspillable). 2 volts 16 A.H. Ideal for 6 volts and 12 volts supply. Brand new original cartons. Size 4in. × 7in. × 2in. **5/6** each, P.P 2/6; 3 for **15/-,** P.P. 3/6; 6 for **27/6,** P.P. 5/-.

S.T.C. RECTIFIER UNIT. Input 100-250 v. A.C. Output 115 v. D.C. at 1 amp. Provision for adjustment of 3 and 12 volts either side of mean voltage. **55/-,** carr. 5/-.

0-25 AMPS. 2½in. ROUND FLUSH MOUNTING METERS. New and boxed, **8/6.** Post 1/6.

SIGNAL GENERATOR AND WAVEMETER. Type W.1649. Frequency of Signal generator: 140 to 240 Mc/s. Accuracy +0.5 Mc/s. Frequency of Heterodyne Wavemeter: 155-255 Mc/s. Accuracy + 0.2 Mc/s. Containing VR 135 and 4VR91, 5 meg. crystal. Retractable aerial. Power requirements: 6.3 volts and 120 volts. Unit housed in copper lined wooden case. Size 15½in. × 13in. × 14¼in., **45/-,** plus 10/- carr.

FERRANTI TRANSFORMER. Input 225 volts, output 4 volts at .5 amps. Potted type with ceramic bushes. Brand new, **7/6** each. P. & P. 1/-.

VIBRATOR PACK. 12 volt input 300 volts output at 150 mA. As a bridge rectifier will handle 450 volts RMS at 120 mA. Pack consists of 12 volt vibrator, 4 metal rectifiers, chokes and smoothing condensers. ONLY **30/-.** carriage 5/-.

TANNOY AMPLIFIER. With 4 6L6's in parallel, push-pull handling from 30 to 60 watts. 200-250 v. input. Complete with all leads, hand microphones, plugs and spares. Housed in wooden transit case 17½ × 15¾ × 21¼in. With full operating instructions and circuit. Fully tested. ONLY **£20.** Speakers for above **25/-** each.

AMERICAN MIDGET ACCUMULATORS. 36 volts, lead acid type. **2/6** each. P. & P. 1/-.

COLVERN WIRE WOUND POTENTIOMETERS. 25 watts 50k and 100k. Price **6/-** each.

HEADPHONE & MICROPHONE ASSEMBLY. Consisting of padded headphones and No. 7 moving coil hand microphone with cord and plug. Brand new Price **10/-.** P. & P. 3/6.

PYE 45 mc/s. I.F. STRIPS. Complete with seven valves, 6-EF50, 1-VR92, 6 tunable I.F. transformers. Only **30/-,** post paid

COMMAND RECEIVERS. 190-550 kc/s., fully valved, **55/-.** P. & P. 3/6.

LOOP ASSEMBLY CRV. 69365. Suitable for use with communication Receivers with aural D/F. Loop is for manual operation and fitted with calibrated scale and 28 inch drive extension. Weight 15 lb. Height 4 feet. R.C.A. manufacture and brand new in original cartons **£6/10/-,** carriage 20/-.

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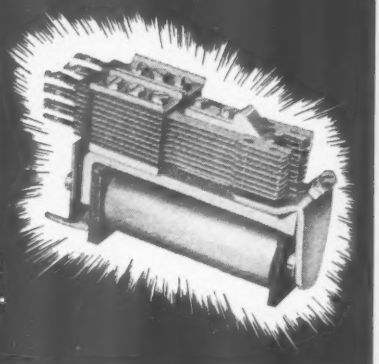

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MINIATURE COILS
FOR TRANSISTOR RADIO CIRCUITS

These are the smallest screened coils available on the British market or the Continent.

DIMENSIONS:—

Height (Excluding Lugs) ..	5/8in.
Diameter (Top)	9/16in.
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★Latest high-efficiency ferrite pot cores and litz windings.

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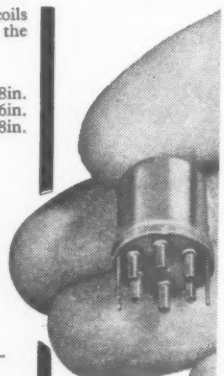

THREE TYPES AVAILABLE:—

List		*List Price*
735	Oscillator Coil	**11/3 each**
736	1st or 2nd I.F. transformer.	postage 6d. extra.
737	3rd I.F. transformer	

Connection diagram supplied.

DELIVERY: Ex Stock.

C.W.O., or C.O.D. (1/6d. extra).

Trade, Manufacturers, and Export enquiries invited.

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OSCILLATOR TYPE 180. A variable frequency oscillator of outstanding merit. Frequency coverage 1.5 to 20 Mc/s. Employs an electron coupled form of Colpitts oscillator utilising a pair of rotating coils, the outcome of extensive development which enables a setting accuracy to within a few hundred cycles to be achieved. The frequency stability is possibly the best yet in commercial practice being better than 15 cycles per megacycle per degree C. Employs an 807 with a 4003A filament barreter and gives sufficient output to drive a pair of 813's. Incorporates keying facilities and can be switched to crystal operation if desired. Power supply required up to 500 v. D.C. (preferably stabilised) and 12.5 v. A.C. or 6.3 v. with barreter cut-out. 807, barreter and calibration chart included together with detailed circuit diagram and general information applicable to Osc. Unit type 145 (an earlier version of this Unit) but which is similar electrically. These Units were obviously developed to give the best possible performance regardless of cost and the price we are asking can only be a fraction of the manufacturing cost. New in original cartons. PRICE ONLY **£7/10/-**, carriage 12/6.

VARIABLE RESISTANCES. 5.3 ohms to carry 8 amps., worm drive for knob control. Overall size approx. 16in. long × 2¼in. wide × 5in. high. PRICE **12/6**, post 3/-.

SIEMANS HIGH-SPEED RELAYS. Resistance 2,000 ohms, single contact changeover. Ex. Govt., as new. PRICE **9/6**, post 9d.

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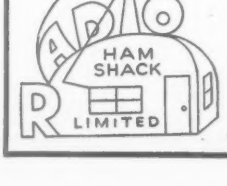

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C.R.T. ISOLATION TRANSFORMERS

For Cathode Ray Tubes having Heater/Cathode short circuit and for C.R. Tubes with failing emission.
Type A. Low leakage windings. Ratio 1 : 1.25 giving 25% boost on Secondary.

2 volt	10/6 each
4 volt	10/6 each with Tag
6.3 volt	10/6 each Panel and
10.8 volt	10/6 each Solder Tags
13.5 volt	10/6 each
Ditto with mains primaries	12/6 each

Type B. Mains input 220/240 volts. Low Capacity. Multi Output 2, 4, 6.3, 7.3, 10 and 13 volts. Input has two taps which increase output volts by 25% and 50% respectively. This transformer is suitable for all Cathode Ray Tubes. With Tar Panel 21/- each. Ditto for 6 volt Tubes only 17/6.
Type C. Low capacity wound transformer for use with 2 volt Tubes with failing emission. Input 220/240 volts. Output 2-2½-2½-3 volts at 2 amps. 17/6 each.
All Isolation Transformers are individually boxed, labelled and clearly marked with circuit data.
NOTE:—It is essential to use mains primary types with T.V. recievers having series connected heaters.

RESISTORS. All preferred values. 20% 10 ohms to 10 meg., ½ w. 6d.; 1 w., 9d.; 1½ w., 9d.; 2 w., 1/-.
HIGH STABILITY. ½ w., 1%, 2/-. All preferred values 100 ohms to 10 meg. Ditto 5%, 9d., 10%, 6d.

5 watt	WIRE-WOUND RESISTORS	1/3
10 watt		1/6
25 watt	25 ohms—10,000 ohms	2/-
15,000 ohms—50,000 ohms 5 w., 1/9; 10 w.		2/3

WIRE-WOUND POTS. 3 WATT LAB. COLVERN, ETC.

Pre-set Knurled Knob.	Min. T.V. Type Slotted Knob.	Standard size Pots., 2½in. Spindle High Grade. All
All values 25 ohms to 30 K. 3/- ea.	50 K., 4/-.	Values, 100 ohms to 50 K., 5/6; 100 K., 6/6.
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O/P TRANSFORMERS. Heavy Duty 50 mA., 4/6. Multi-ratio push-pull, 7/6. Miniature 3V4, etc., 4/6. Hygrade Push-pull 7 watts, 15/6. "510" 6k or 8k 30/-.
I.F. CHOKES 15/10 H. 60/65 mA., 5/-; 25/20 H. 100/120 mA. 12/6; 20/15 H., 120/150 mA., 12/6; H. 250 mA., 15/-.
MAINS TRANS. 350-0-350, 80 mA., 6.3 v. tapped 4 v. 4 a. 5 v. tapped 4 v. 2 a., ditto 250-0-250 80 mA., etc., 22/6. Bargain 300-0-300 v. 65 mA., 6 v. 4 a., 4 v. 2 a., 15/-.

I.F. TRANSFORMERS 7/6 pair

465 kc/s slug tuning miniature can 2½ × 1 × 1in. High Q and good band width. By Pye Radio. Data sheet supplied.
Wearite M300 I.F. transformers 465 kc/s, 12/6 pair.
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ALADDIN FORMERS and cores, ½in., 3d.; 1in., 10d. 3in. FORMERS 5937/8 and Cans TV1/2. 2in. sq. × 2½in. and 1in. sq. × 1½in., 2/- complete with cores.
SLOW MOTION DRIVES. Epicyclic ratio 6 : 1, 2/3.
ITANA. Midget Soldering Iron. 200/220 v. or 230/250 v., 16/6. SOLON INSTRUMENT IRON. 25 w., 24/-.
MAINS DROPPERS. 3 × 1½in. Three Adj. Sliders, .3 amp. 750 ohms, 4/3. .2 amp., 1,000 ohms, 4/3.
LINE CORD. .3 amp., 60 ohms, per foot, .2 amp., 100 ohms per foot, 2 way, 6d. per foot. 3 way, 7d. per foot.

CRYSTAL MIKE INSERT by Acos

Precision engineered. Size only 1½ × 3/16in. Bargain. Price 6/6. No transformer required.

MIKE TRANSF. 50 : 1, 3/9 ea.; 100 : 1, Potted, 10/6.
LOUDSPEAKERS P.M. 3 OHM. 2½in. square, 17/6.
5in. R.A., 17/6. 7in. × 4in. Goodmans 21/-.
3½in. Square Elac., 21/-. 8in. Plessey, 19/6.
6½in. Goodmans, 18/6. 10in. R.A., 30/-.
4in. ELAC TWEETER, 25/-. 12in. Plessey, 30/-.
5in. M.E. 2.5 k. field tapped O.P. transformer 24/6.
15 ohm Plessey 10 wt. 12in. with Tweeter, 97/6.
CRYSTAL DIODE G.E.C. 2/-. GEX34, 4/-. 40 Circuits, 3/-.

TELETRON AJAX CRYSTAL SET

Complete kit with cabinet 4½ × 3 × 1½in. All components and instructions. 15/- or 30/- with pair of lightweight H.R. headphones to match.

H.R. HEADPHONES. 4,000 ohms, brand new. 16/6 pair.
SWITCH CLEANER Fluid, squirt spout, 4/3 tin.
TWIN GANG CONDENSERS. 365 p.f. Miniature, 1½in. × 1½in. × 1½in., 10/-. .0005 Standard with trimmers, 9/-; less trimmers, 8/-. Midget, 7/6; Single 50 p.f., 2/6.
Solid Dielectric 100, 300, 500 pf., 3/6 each.
VALVE HOLDERS. Pax int. Oct., 4d. EF50, EA50, 6d. B12A, CRT, 1/3. Eng. and Amer. 4, 5, 6, 7 and 9 pin, 1/-.
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CERAMIC, EF50, B7G, B9A Oct., 1/-. B7G with can, 1/9.
SPEAKER FRET. Gold Cloth 17in. × 25in., 5/-. 25in. × 38in., 10/-. Expanded metal, Silver 15½in. × 9½in., 2/-. Tygan 4ft. 6in. wide, 10/- ft.; 2ft. 3in. wide, 5/- ft.
WAVECHANGE SWITCHES.
2 p. 2-way 3 p. 2-way, short spindle..... 2/6
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Wave change "MAKITS." 1 wafer 8/6; 2 wafer 12/6; 3 wafer 16/-; 4 wafer 19/6; 5 wafer 23/-; 6 wafer 26/6.
TOGGLE SWITCHES. S.P., 2/-; D.P. 3/6; D.P.D.T., 4/-.
MORSE KEYS, good quality 2/6. Buzzers 3/6.

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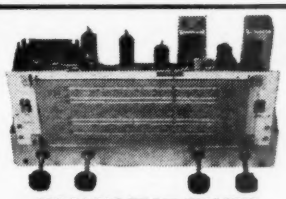
A really first-class 3-valve 3-watt Amplifier giving Hi-Fi quality. Valve line-up: EF86, EL84, EZ80. H/duty mains trans. giving extra HT and LT for Tuner Unit addition. Variable treble cut and bass boost controls. 5-watt output. Complete amplifier wired and tested with output transformer to Mullard specification. £7.17.6. Carr. and ins. 2/6.



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THREE WAVEBANDS FIVE VALVES
S.W. 16 m.—50 m. LATEST MULLARD
M.W. 200 m.—550 m. ECH42, EF41, EBC41,
L.W. 800 m.—2,000 m. EL41, EZ40
12 month Guarantee. A.C. 200/250 v., 4-way switch. Short-Medium-Long-Gram. A.V.C. and Negative feedback. 4.5 watts. Chassis 13½in. × 6½in. × 2½in. Glass Dial 10¼ × 4½in. horizontal or vertical available. 2 Pilot Lamps. Four Knobs, Walnut or Ivory, aligned and calibrated. Chassis isolated from mains.

BRAND NEW £10.10.0 Carr. 4/6.

TERMS: Deposit £5/5/- and 6 monthly payments of £1.
MATCHED SPEAKERS FOR ABOVE CHASSIS: 8in., 17/6; 10in., 25/-; 12in., 30/-.

★ COLLARO ★
HIGH FIDELITY AUTOCHANGER
MODEL RC456

For 7", 10", 12" Records 16, 33, 45, 78 r.p.m.
4-SPEEDS—10 RECORDS
WITH STUDIO "O" PICK-UP
BRAND NEW IN MAKER'S BOXES

OUR PRICE £9.15.0 Post free.

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SUITABLE PLAYER CABINETS 49/6
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IMPORTANT NOTICE

THESE RECORD PLAYERS AND AUTO-CHANGERS ARE GUARANTEED FOR TWELVE MONTHS AND SPARES ARE AVAILABLE.

GARRARD 4-SPEED SINGLE RECORD PLAYER 4SP

£8 AUDIO PERFECTION POST FREE

Designed to play 16, 33, 45, 78 r.p.m. Records, 7in., 10in., 12in. Lightweight Xtal pick-up, GC2 turnover head, two separate sapphire styli, Standard and L.P.

EXCEPTIONAL OPPORTUNITY

COLLARO 4-speed Single Record Player, including heavyweight turntable and lightweight Studio O Pick-up with turnover Xtal mounted on baseplate. Autostop fitted. **OUR PRICE 6 gns.** Carr. 4/-
Amplifier Player Cabinets, 45/-.

BUILD THIS REPRODUCER BARGAIN SPECIAL SINGLE PLAYER KIT

FAMOUS MAKER'S SURPLUS STOCKS

4-speed Collaro "Junior" Unit....	£4	12	6
Handsome portable case, 17½ x 13½ x 7in.	£2	5	0
Ready-built 3 watt amplifier with two valves and loudspeaker.....	£3	12	6

All available separately. Post 2/6 each.
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COSSOR COMPANION
SUPERHET MODEL 527/X FOR ALL-DRY BATTERY OPERATION

S.W.1 13.6 to 43 metres, S.W.2 42.8 to 136 metres, Medium 187 to 575 metres

A fine all-wave receiver giving world-wide reception on three wavebands. Operation is from a single dry battery, very economical low consumption valves DK92, DF96, DAF96, DL96

6in. ELLIPTICAL LOUDSPEAKER

The cabinet is attractively presented in maroon and beige with gold trimmings.

SIZE 9½ × 6½ × 4½in. Leaflet S.A.E.

OUR PRICE £6.6.0 (Battery 17/6 extra)
Carriage and insurance 4/-

THE HI-GAIN BAND 3 PRE-AMP

Cascode circuit using Valve ECC84. Complete kit 29/6 less power; or 49/6 with power pack kit. Plans only 1/6.

Volume Controls

Midget size
Long spindles. Guaranteed 1 year. All values 10,000 ohms to 2 Meg. No. Sw. D.P.Sw.
3/- 4/9
Linear or Log Tracks

80 ohm CABLE Coaxial

Semi-air spaced Polythene insulated 2in. dia. Stranded core. Ideal Band III. 9d. yd. Losses cut 50%.

FRINGE QUALITY
AIRSPACED.... 1/6 yd.

COAXIAL PLUGS	1/-	DOUBLE SOCKET	1/3
SOCKETS	1/-	OUTLET BOXES	4/6

BALANCED TWIN FEEDER per yd. 6d. 80Ω or 300Ω.
TWIN SCREENED BALANCED FEEDER 1/- yd., 80 ohms.
TRIMMERS, Ceramic, 30, 50, 70 pf., 9d. 100 pf. 150 pf. 1/3. 250 pf., 1/6. 600 pf., 750 pf., 1/9. Phillips, 1/- ea.

ALUMINIUM CHASSIS. 18 s.w.g. Plan, undrilled, with 4 sides, riveted corners and lattice fixing holes, with 2½in. sides. 7 × 4in., 4/6; 9 × 7in., 5/9; 11 × 7in., 6/9; 13 × 9in., 8/6; 14 × 11in., 10/6; 15 × 14in., 12/6; and 18 × 16 × 3in., 16/6.

BLACK CRACKLE PAINT. Air drying, 3/- tin.
P.V.C. CONN. WIRE, 10 colours, single or stranded, 2d. yd.
NEON MAINS TESTER SCREWDRIVERS, 5/-.
SOLDER RADIOGRADE 3yds. 9d. ½ lb. 2/6.

12/6 PURETONE RECORDING TAPE

1,200 ft. on standard fitting 7in. metal reels. Spare Reels 5½in. plastic, 3/-; 7in. plastic, 4/-.

SUPERIOR 1,200ft. Plastic Tape 21/- on 7in. plastic reels.

SENTERCEL RECTIFIERS. E.H.T. TYPE FLY-BACK. VOLTAGES. K3/25 2 kV., 5/-; K3/40 3.2 kV., 7/-; K3/45 3.6 kV., 7/6; K3/50 v. 4 kV., 8/-; K3/100 8 kV., 14/6. 50 c.p.s. Voltage 30% of above.
MAINS TYPE, RM1, 125 v., 60 mA., 5/-; RM2, 100 mA., 6/-; RM3, 120 mA., 8/-; RM4, 250 v. 275 mA., 16/-.
MINIATURE CONTACT COOLED RECTIFIERS. 250 v. 50 m/a., 7/6; 60 m/a., 8/6; 85 m/a., 9/6.
COILS. Wearite "P" type, 3/- each. Osmor Midget "Q" type adj. dust core, from 4/- each. All ranges.
TELETRON. L. and Med. T.R.F., with reaction, 3/6.
FERRITE ROD AERIALS. M.W., 8/9; M. and L., 12/6.
T.R.F. COILS A/HF, 7/- pair. H.F. CHOKES, 2/6.

JASON F.M. TUNER COIL SET, 25/-. H.F. coil, aerial coil, Oscillator coil, two I.F. Transformers 10.7 Mc/s., Detector transformer and heater choke. Circuit and component book using four 6AM6, 2/-. Complete kit with Jason superior calibrated dial, £6/15/-. Mercury Complete Kit, £9/19/6.

CONDENSERS. New stock. .001 mfd. 7 kV. T.C.C., 5/6. Ditto 20 kV., 9/6; 100 pf. to 500 pf. Micas, 6d.; Tubular 500 v. .001 to .01 mfd., 9d.; .05 .1, 1/-; .25, 1/6; .5, 1/9; .1/350 v., 9d.; 0.1 mfd. 2,000 v., 3/6; 0.01 mfd. 2,000 v. 1/9.
CERAMIC CONDS. 500 v. .3 pf. to .01 mfd., 10d.
SILVER MICA CONDENSERS. 10% 5 pf. to 500 pf., 1/-; 600 pf. to 3,000 pf., 1/3. CLOSE TOLERANCE: 1 pf., 1.5 pf. to 47 pf., 1/6. DITTO 1% 50 pf. to 815 pf. 1/9; 1,000 pf. to 5,000 pf., 2/-.

NEW ELECTROLYTICS. FAMOUS MAKES.

TUBULAR		TUBULAR		CAN TYPES	
1/350 v.	2/-	100/25 v.	3/-	8+16/450 v.	5/-
2/450 v.	2/3	8+8/500 v.	4/6	16+16/450 v.	5/6
4/350 v.	2/-	16+16/500v.	6/-	6,000 mfd. 6 v.	6/6
8/450 v.	2/3	CAN TYPES		32+32/350 v.	4/6
8/500 v.	2/9	Clips 3d.		32+32/450 v.	6/6
16/450 v.	3/6	16/450 v.	3/6	64+120/275 v.	7/6
16/500 v.	4/-	16/500 v.	4/-	60+100/350 v.	11/6
32/450 v.	5/6	32/320 v.	4/-	100+200/275 v.	
25/26 v.	1/9	100/275 v.	5/6		12/6
50/25 v.	1/9	50+50/350 v.	7/-	1,000+1,000/6 v.	
50/50 v.	2/-	500/12 v.	3/-		6/6

FULL WAVE BRIDGE SELENIUM RECTIFIERS. 2, 6 or 12 v. 1½ amp., 8/9; 2 a., 11/3; 4 a., 17/6.
CHARGER TRANSFORMERS. Tapped input 200/250 v. for charging at 2, 6 or 12 v. 1½ a., 15/6; 2 a. 17/6; 4 a., 22/6.

VALVES

	All boxed			New & Guaranteed	
1R5	8/6	6K8	8/6	EA50	1/6
1S5	8/6	6L6	10/6	EAB80	8/6
1T4	8/6	6Q7	10/6	EB91	8/6
3S4	8/6	6S7	7/6	EBC33	8/6
3V4	8/6	6SN7	8/6	EBC41	10/6
5U4	8/6	6V6G	7/6	EBF80	8/6
5Y3	8/6	6V6GT	8/6	ECC84	12/6
5Z4	10/6	6X4	7/6	ECF80	10/6
6AM6	8/6	6X5	7/6	ECF82	10/6
6B8	5/6	787	8/6	ECH42	10/6
6BE6	7/6	12A6	7/6	ECL82	12/6
6BH6	10/6	12AH8	10/6	EF39	7/6
6BW6	8/6	12AT7	10/6	EF41	10/6
6BW7	8/6	12AU7	10/6	EF50	5/6
6CH6	10/6	12AX7	10/6	Equip.	
6D6	7/6	12BE6	10/6	EF50	8/6
6F6	7/6	12BH7	10/6	8ylv.	
6H6	3/6	12K7	8/6	EF80	10/6
6J5	6/6	12Q7	8/6	EF92	5/6
6J6	7/6	35Z4	10/6	EL32	5/6
6J7	8/6	80	8/6	EL84	10/6
6K6	6/6	807	6/6	EY51	12/6
6K7	5/6	954	1/6	EZ40	10/6
				EZ81	11/6
				E1148	1/6
				HABC80	12/6
				HVR2A	7/6
				MU14	10/6
				P61	8/6
				PCC84	12/6
				PCF80	10/6
				PCF82	10/6
				PCL82	10/6
				PEN25	6/6
				PL82	10/6
				PY80	10/6
				PY81	10/6
				PY82	10/6
				8P61	5/6
				UBC41	10/6
				UCH42	10/6
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				UL41	10/6
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Post etc. 2/6 extra.
Smaller than H.T. Battery alone!

6K7G Valves	2/11 Each	6B8G Valves	2/11 Each
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PCC84 Valves	9/6 Each	Any Parcel Insured against Damage in Transit. 6d. Extra.	Post Etc. 6d. per valve Extra. Over £3 Post free.
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NEW AND SURPLUS GUARANTEED VALVES ALL TESTED BEFORE DESPATCH
S.A.E. WITH ENQUIRIES

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AR88 FILTER PACK 3×4 mfd., 500 v. (new), 25/- each. P.P. 2/6.
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0.25 mfd., 2 kv. wkg., 2/6 each. 1 mfd., 400 v. wkg., 2/6 each. 1 mfd., 2 kv. wkg., 3/6 each. 2 mfd., 600 v. wkg., 4/- each. 3 mfd., 400 v. wkg., 4/- each. 4 mfd., 400 v. wkg., 4/6 each. 4 mfd., 1 kv. wkg., 5/6 each. 6 mfd., 400 v. wkg., 5/6 each. 8 mfd., 1,200 v. wkg., 11/6 each. 0.1 mfd., 4 kv. wkg., 4/6 each. 0.5 mfd., 5 kv. wkg., 7/6 each. 0.5 mfd., 2 kv. wkg., 2/6 each. 1 mfd., 750 v. wkg. 3/- each. 2 mfd., 400 v. wkg., 3/6 each. 2 mfd., 1.5 kv. wkg., 4/6 each. 3 mfd., 400 v. A.C. wkg., 5/- each. 4 mfd., 600 v. wkg., 5/- each. 4 mfd., 2 kv. wkg., 6/6 each. 8 mfd., 500 v. wkg., 4/9 each. 10 mfd., 440 v. A.C. wkg., 12/6 each. 80 mfd., 300 v. wkg. 27/6 each. 50+50 mfd., 300 v. A.C. wkg., 30/- each.
CERAMIC TYPES. 50 pf., 100 pf., 110 pf. and 1,000 pf., 10 kv. wkg., 3/6 each. 100 assorted Silver Micas 22/6. 100 assorted resistors 15/-.
MIDGET ROTARY TRANSFORMERS. Input 11.5 v., output 365/310 v. 30 ma., 25/- each.
XTAL HOLDERS to suit large or small size, 1/6 each.
VIBRATOR TRANSFORMERS. Input 12 v. CT, 140 v. 50 ma., 5/6 each.

AVAILABLE SOON. Transmitters BC640 6ft. rack VHF, 100/150 Mc. Also Transformers 720-0-720, 6.3 v. and 5 v., "C" core type. Please write for further details on these items.

R.F. UNITS type 26B. Brand new in cartons, 18/6 each. P.P. 2/6.
RECEIVER BC 624C (part of SCR 522). This well-known receiver covers 100 to 156 Mc., the "C" is the latest type which incorporates several mods. over the earlier models, noise limiter. AVC, squelch circuit and extra audio stage. The power requirements are 300 volts 70 m/a. H.T. 12 volts 3 amp. L.T. New and complete with 11 valves, £2/2/6 each. P.P. 3/6.
WAFER SWITCHES. 4 p. 3 w., 2/- each; 4 p. 2 w. 1/6 each (with 1in. spindle); 2 p. 4 w., 1/- each; 1 p. 8 w., 1/- each (with ¼in. spindle).
RHEOSTATS W/W. 30 ohms, with S.P. switch, ¼in. spindle, 2/- each.
DUAL POTS. 2×1 megs., 1¼in. spindle, 2/- each. 500 k. pots with S.P. switch, 1¼in. spindle, 2/3 each. 50 k., 100 k., 500 k., pots with 1in. spindle, 10/- per doz.
SPIRIT LEVELS, small for instruments, etc. 1in. long, ¼in. wide, 1/- each.
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COLVERN W/W pots. 25 k. and 50 k. (preset), 1/6 each or 15/- doz.
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5-AMP. SWITCH SOCKET, flush mounting, 4/6 each, 1/- post.
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RE-ENTRANT SPEAKERS. 10 ohms, 15 watts, new, £5/10/- each.
RE-ENTRANT SPEAKERS. 15 ohms, 20 watts. Not new, good cond., £4 each.
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3-B TRULOCK ROAD, TOTTENHAM, N.17
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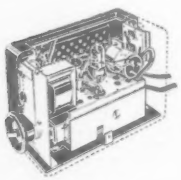
13 Channel Converter

for I.T.A.—£5.5.0 (p. & p. 3/-)



Illust. with half of moulded case removed. 3-position switch giving Off-I.T.A.-B.B.C. Valves PCF80 and PCC84. In moulded case 8½ x 4½ x 6in. High gain, low noise.

CO-AXIAL cable, low loss, 8d. yd.
AERIALS, Band 3, 5-element, 35/-; 9-element, 55/-; for fixing to existing mast, 1in. to 2in. dia. (carr. pd.).
AUTO-CHANGERS, Collaro RC457, 4-speed, mixer, 200v.-250v. A.C. Turnover crystal head, £8/16/6 plus 5/- carr. **SINGLE PLAYER** Collaro AC3/554, 3-speed, turnover crystal pick-up. £6/16/6 (3/6 carr.).
BATTERY ELIMINATOR for 4 low consumption valves, 90v. 15 m/a. and 1.4v. 250 m/a., 35/- (p. & p. 2/6).
I.T.A. TURRET TUNERS, Brayhead and Cyldon, £7/7/- (state B.B.C. and I.T.A. and make and model number of T.V.).

ALL NEW GOODS. 12 months' guarantee on converters.
3 months' on valves. Terms available.

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1,000 kc/s crystal controlled, with switched 100 kc/s and 10 kc/s locked multi-vibrators.

This excellent unit is as new, and is contained in polished bakelite case with carrying handle. The circuit uses 6 valves and operates from 2 v. l.t. and 120 v. h.t.

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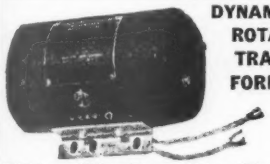

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D.C. input 13.5 v. Output 285 v. at 75 mA. **57/6.**
D.C. input 27 v. Output 285 v. at 75 mA. **37/6.**
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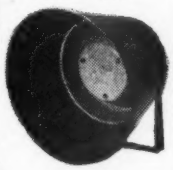
Impedance 7½Ω. 6-8 watts output. Weight 10lb. Size 7½in. Depth, 10in. Diam. Easy Fixing. Weatherproof. Spun solid steel. Hammered finish.
PRICE **£3/10/-.**
Carriage & Packing 7/6.



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BRAND NEW
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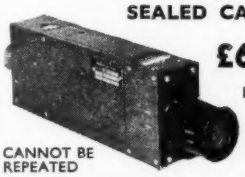

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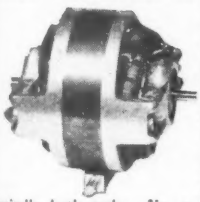
F/3.5 Triple Anastigmatic lens. 16 frames per sec. Complete with magazine and 24 v. motor.

UNREPEATABLE OFFER LESS THAN HALF MANUFACTURER'S COST



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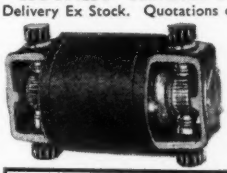

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Input 11.5 v. Output 250 v. at 125 mA.

H.T.32
Input 11.5 v. Output 490 v. at 65 mA.

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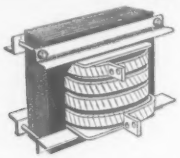

10 V. at 1,000 amps. £34.
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3-5-8-10-15-17-21-25 V. at 100 amps. £19.
60 V. at 100 amps. £18.
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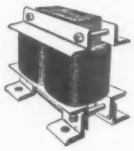

Input 220/250 V. £5/12/- each.
Outputs:
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Many other STOCK TRANSFORMERS with outputs up to 25,000 amps at low voltages.

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Input 200/250 V. A.C.
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OTHER RECTIFIER SETS with outputs up to 200 amps.

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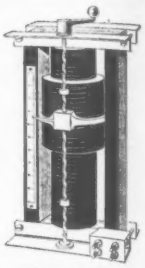

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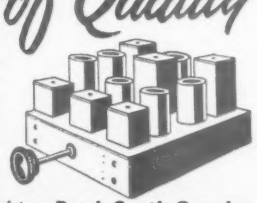

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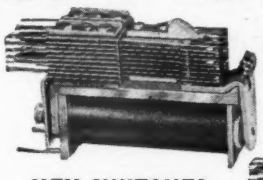

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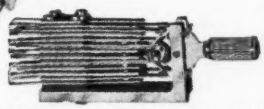

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1	,,	2½in.	MC/FR	35/-
5	,,	2in.	MC/FR	17/6
30	,,	2½in.	MC/FR	12/6
100	,,	2½in.	MC/FR	12/6
200	,,	2½in.	MC/FR	12/6
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25	,,	2½in.	MI/FR	7/6
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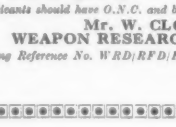
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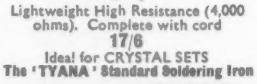
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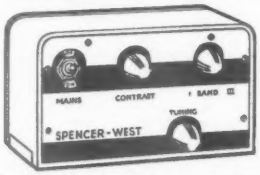

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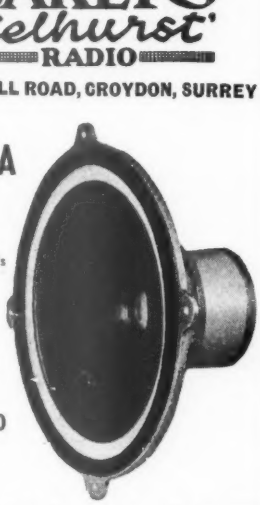

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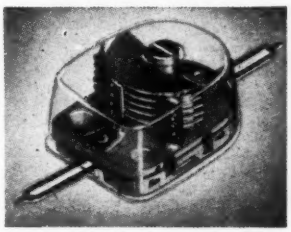

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THE M.O. VALVE CO. LTD.

has a vacancy for a

GRADUATE,

or candidate with similar professional qualifications in an

EXPERIMENTAL MICROWAVE

department, to work in the development of special valves. Experience in microwave techniques is desirable.

This is a new project carried out in close collaboration with

The RESEARCH LABORATORIES of The G.E.C. Ltd.

and is a good opportunity for some wishing to widen his experience in microwave techniques.

Candidates are invited to reply, quoting BH/1 to Personnel Officer, M.O. Valve Co. Ltd., Brook Green, Hammersmith, W.6.

RADIO TELEPHONE/ELECTRONICS MECHANIC

for

BAHRAIN PETROLEUM COMPANY LIMITED

APPLICATIONS for this position are invited from men twenty-six to thirty-five years of age having a City and Guilds Qualification in Radio II and Line Practices II or Telephone Exchanges II. They must have served a recognised apprenticeship and have had recent practical experience in the installation and maintenance of R/T systems fixed and mobile both AM and FM using VHF, including Marconi RLS 3 and H.P. 82. Some working experience of Cinema equipment and of Teleprinter Maintenance would be an advantage.

The commencing salary is £1,164 per annum in addition to which free air-conditioned accommodation, and a living allowance are provided. An initial kit allowance, medical attention, paid local and home leaves and participation in Pension and Provident Fund plans are also provided. Apply in writing, quoting "CMS" with full particulars of qualifications and experience to

Caltex Services Limited,
Caltex House, Knightsbridge Green,
London, S.W.1.

SWEDISH IMPORTER

WANTS URGENTLY

Radio and Hi-Fi Kits of parts for home construction with tubes and transistors, miniature components, loudspeakers, LP records, etc.

Offers with catalogue and lowest export prices soonest to

TELMECO IMPORT,
BOX 624,
STOCKHOLM 1. SWEDEN

FERRANTI LIMITED, EDINBURGH

are anxious to engage a

TECHNICAL AUTHOR

with at least two years' experience in the electronic field, for the preparation of technical handbooks on radar and fire control systems. A substantial salary will be offered to the successful candidate. Congenial working conditions. Staff superannuation scheme is in operation.

Please apply to the
Personnel Officer, Ferranti Limited,
Ferry Road, Edinburgh, 5
quoting Ref. 59/TA.

XUM

RADIO TECHNICIANS
IN
CIVIL AVIATION

A number of appointments are available for interesting work providing and maintaining aeronautical telecommunications and electronic navigational aids at aerodromes and radio stations in various parts of the United Kingdom.

Applications are invited from men aged 19 or over who have a fundamental knowledge of radio or radar with some practical experience. Training courses are provided to give familiarity with the types of equipment used.

Salary £600 at age 25 rising to £705. The rates are somewhat lower in the Provinces and for those below age 25. Prospects of permanent pensionable posts.

Opportunities for promotion to Telecommunications Technical Officer are good for those who obtain the O.N.C. in Electrical Engineering or certain City and Guilds Certificates. The maximum salaries of Telecommunications Technical Officers are Grade III £870, Grade II £1,030, Grade I £1,250.

Apply to the Ministry of Transport and Civil Aviation (ESB1/RT), Berkeley Square House, London, W.1, or any Employment Exchange (quoting Order No. Westminster 2109).

TELEVISION RESEARCH AND DEVELOPMENT

A fully qualified and experienced Television Engineer is now required to join an expert team of Engineers engaged in one of the most advanced technical development programmes in the industry. This includes colour research; wide angle scanning; combined T.V./F.M. Radio Receivers; advanced (but realistic) projects.

The well-equipped Laboratories of the Company are situated in a convenient West London district, and a high commencing salary will be offered to the right man. The position is permanent and pensionable, and offers considerable scope for advancement.

Please write (in strict confidence), giving full particulars of experience, qualifications, present salary level, to Box No. 5156, c/o "Wireless World."

THE PLESSEY COMPANY LIMITED
urgently require
ELECTRONIC ENGINEERS
for
STAGE AND SYSTEM TESTING
of
COMPLEX ELECTRONIC
and
ELECTRO-MECHANICAL EQUIPMENTS

Candidates must be fully experienced in handling normal test gear (other than for VHF) and have a sound theoretical knowledge of electronics. The situations are permanent and the work is both interesting and varied.

Successful applicants will be given earliest priority for housing: need not start until housed and will receive help with removals.

Applications from British Subjects only should be made either in writing or in person to:

Personnel Officer,
Cheney Manor,
Swindon, Wiltshire.

WIRELESS TELEGRAPHY OPERATOR
required by
FALKLAND ISLANDS GOVERNMENT

Wireless Station, Port Stanley on contract for one tour of three years in first instance. Salary according to experience in scale £360 rising to £600 a year. Full board accommodation obtainable at £12—£14 a month. Free passages. Liberal leave on full salary. Candidates must be SINGLE and have had good practical operating experience. P.M.G. certificate an advantage. Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/41891/WF.

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for service in SOUTH GEORGIA on contract for one tour of 24/30 months in first instance. Fixed salary £780 a year. Free board and lodging. Free passages, Liberal leave on full salary. Candidates must be SINGLE and preferably hold 1st class P.M.G. Certificate.

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This Company has immediate vacancies at St. Albans in its Technical Literature (Telecommunications) Section; applicants should have electrical engineering qualifications and/or experience in the design or development of electronic equipment; the duties are varied and interesting and the posts provide permanent and pensionable positions in a well-established Company.

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1. **ELECTRONIC DESIGNERS.**
2. **ELECTRONIC DRAWING OFFICE SECTION LEADER.**
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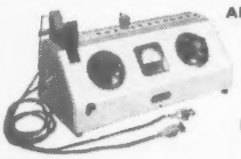
Tel.: AMBassador 0151/2

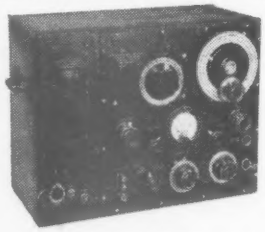
A. R. B. Approved Stockists.



ARMATURE DROP TESTERS (Ex A.M. Ref. 5G/549)

For testing Motor and Generator Armatures, max. dia. of commutator approx. 4in.; max. overall dia. 7in.; max. length approx. 15in. PRICE £5/10/-. Packing and carriage 15/-.

GENERAL RADIO TYPE 605B "STANDARD" SIGNAL GENERATOR



Range: 9.5 kc/s to 30 mc/s in seven bands.
Accuracy: ±1% Power supplies 230 v. A.C.
Output: 0.5 μV. to 0.1 V. and constant output of 1 V.
The instrument contains a separator stage which ensures that load variations will not affect the carrier frequency.
PRICE, fully overhauled and guaranteed £60 0 0
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MARCONI TYPE TF-340 OUTPUT POWER METERS
Meter calibration: 50 mW/17 db F.S.D.
Meter multipliers: 0.1–1.0–10–100.
Impedance values: 25–30–40–50–60–80–100–125–150–200 ohms.
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HALLICRAFTER S-27C U.H.F. COMMUNICATION RECEIVERS. Frequency range 130 to 210 mc/s; two RF stages; three IF stages; AM and FM detectors; two audio stages; "S" meter; I.F. 16 mc/s; power supplies 115 V. A.C.
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B.S.R. Type LO-50 Beat Frequency Oscillator, 0 to 16,000 c/s, two dial differential tuning; output approx. 0.5 watts; Mains operated.
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Eversheds Series 2, 500 volt Megger Insulation Tester in leather carrying case £25 0 0
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Eversheds Bridge Megger, 500 v..... £45 0 0
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All above are fully guaranteed for six months

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8in. mirror scale, 160 v. range..... £5 0 0
5in. mirror scale, dual range, 150 v. and 300 v. £5 19 6

MILLIAMMETER AND VOLTMETER RECORDERS
Single and double pen. Details and prices on application. New step-down transformers 230/115v. rating 2kVA £5 10 0

T.C.S. COLLINS TRANSMITTING AND RECEIVING EQUIPMENT. Frequency range 1.5 to 12 mc/s., crystal controlled or VFO operation; output 20 W. voice or 40 W. C.W. Complete installation consists of: Transmitter, Receiver, Remote Control Unit with built-in Loudspeaker, Antenna Loading Coil, three interconnecting cables; Power Supply Unit for 12 v., 24 v., 115 v. or 230 v. D.C., or 230 v. A.C.; Headphones, Hand Microphone and Key. **These installations are especially suitable for use on board ships, small craft, etc.** Large assortment of spares available. Particulars on application.

2.5 kVA WELDING TRANSFORMERS for 230 v. mains. Two output sockets 25 amp. and 50 amp. at 50 v. Output voltage adjustable by means of "off-load" tappings. Permissible momentary overload up to 100W. Waterproof input and output sockets.
PRICE, brand new £15 0 0
Carriage £1 10 0

TS-45/APM3 "X" BAND SIGNAL GENERATOR AND TRANSMITTER OUTPUT POWER AND FREQUENCY METER
Frequency range: 8,700 to 9,525 mc/s. Power measurement range: 5 watts. R/F. output: 10mW R.F. average. Power supplies: 110/115 v. A.C.
Details and prices on application.

AMONGST MANY OTHER ITEMS, THE FOLLOWING ARE AVAILABLE TO PERSONAL CALLERS IN OUR RETAIL SHOP AT 85, Tottenham Court Road, London, W.1. *(Open all day Saturday)*
Late closing day Wednesday—open until 7 p.m.

Please address all correspondence, postal enquiries, Mail Orders (these should include 2/- in £ for packing and carriage) to our Head Office.

ARR-3 FREQ. MOD. RECEIVERS. 60 mc/s. band; 2 R.F. stages, 2 I.F. stages, 2 A.F. stages, auto. freq. control. Complete with circuit diagram, modification instructions and modification kit for conversion to VHF band £5 10 0
Also ready converted..... £6 10 0

RECEIVERS. R-1155-B, tested..... £8 10 0

RAY-5 U.S. NAVY RECEIVERS. 25 m/cs. band. Crystal controlled, single channel, complete with 11 valves, 24 v. dynamotor, and instruction manual, brand new..... £2 5 0

TRANSMITTER-RECEIVERS No. 19 Mk. 2.
Complete with valves..... £2 0 0
Without valves £1 0 0

RECEIVERS. P-104 (R-1392), 95 to 150 mc/s. from £3 10 0

CRYSTAL MONITORS TYPE 4A MAINS OPERATED, complete with VR66, two VR91, VR92, CV51, CV57, VU39 ..... £2 10 0

EDDYSTONE MAINS POWER PACKS.
175 v. H.T., 6.3 v. L.T..... £1 15 0
300 v. H.T., 200 m/a. and 12 v. L.T. at 3 amps. £2 8 6

SPARES FOR AR-88D RECEIVERS.
I.F. Coils, 12/6 each; Set of four, 40/-. I.F. Crystal Load Transformers, 12/6 each. Dial Windows, 15/- each. Main Tuning Dials, 10/- each. Small knobs, 4/- each. Flexible Couplings, 2/- each. Filter Capacitors, 50/- each.

LOUDSPEAKERS
8in. P.M. Loudspeakers with Multi-tap matching transformers, in handsome wooden cases ..... each £1 5 0
TANNOY Loudspeakers ..... each £1 0 0

HEADPHONES
CLR, Low Impedance 5/6
CHR, High Impedance 10/-
DLR5, Low Impedance, 6si. Armature.... 7/6
DHR, High Impedance, Bal. Armature 15/-
HS-30/U AS Army Lightweight Headset with miniature earplug earpieces..... 12/-
R.A.F. Headset Assy., comprising rubber headband with chamois leather earpads, connector with bell plug, two low impedance earpieces and el-m microphone 32/6

METERS
2½in. Sq. Fl. 100 μA FSD with four Germanium diodes 22/6
2½in. Rd. Plug-in Type Plain Scale, 600-0-600 μA FSD 12/6
2½in. M.I. A.C. Voltmeter, 300 v..... 20/-
3½in. Rd. Fl. M.C., 500-0-500 μA, FSD... 40/-
3½in. Rd. Fl. M.C., 100-0-100 μA..... 55/-
3½in. Rd. Fl. M.C., 1 mA. FSD 50/-
3½in. Rd. Fl. M.C., 120 v., 200 ohms per volt 15/-
Cross-pointer meters (L-R) containing two 100 microamp movements 12/6
Many other types in stock.

TWO-DECADE WHEATSTONE BRIDGES. 0 to 200 ohms (Demolition Test Sets) 40/-
WESTON VOLT-OHMMETERS, model 564-3C, 1,000 ohms per volt; voltage ranges 3-30-300-600 v. (D.C. only) resistance 1-10-100-1,000 k ohms. Brand new, in leather case, complete with prods..... £4/5/-
MICROSWITCHES. NEW, from..... 2/6
TRANSISTORS: L.F., 8/6; MF, 19/6.

E.H.T. PYRANOL CAPACITORS, 0.03 mF., 15 kV. Size 8 x 4 x 1¾in.....each 21/-

FULLY GUARANTEED VALVES

3B24	4/-	6N7	7/-	EB91	5/-
5U4G	7/-	6SJ7	7/6	EBC33	7/-
6A3	4/-	6SK7	5/6	EF39	5/-
6AC7	6/-	6SL7	7/-	OD3/VR150	5/6
6AG5	3/6	6SN7GT		VR105-30	5/6
6AG7	10/-		7/-	**C.R. TUBES**	
6AL5	4/-	6SQ7	8/-	5CP1	50/-
6AM6	4/6	6Z3	12/-	**CRYSTALS**	
6B4G	5/6	53A	4/-	IN-21B	7/6
6B8	6/-	446A	20/-	**KLYSTRONS**	
6C4	2/6	532A	5/6	417A	40/-
6F33	5/-	807	5/6	**MAGNETRONS**	
6H6	1/9	813	70/-	5J30, QK60, QK61,	
6J5	4/6	955	1/6	QK62	40/-
6J6	3/6	9006	2/6	**MAGNETRONS**	
6K7	6/-	EAC91	5/-	2J51A: price on application.	
6L7	10/-				

Many other types in stock.

Please inspect our Self-Service Counter with fixed-price items ranging from 2d to 10/-.

WE BUY HIGH QUALITY TEST EQUIPMENT, AMERICAN COMMUNICATION RECEIVERS, AIRCRAFT TRANSMITTERS AND RECEIVERS ETC.

Wireless World Classified Advertisements

Rate 7/- for 2 lines or less and 3/6 for every additional one or part thereof, average lines 6 words. Box Numbers 2 words plus 1/-. (Address replies: Box 0000 c/o "Wireless World" Dorset House, Stamford St., London, S.E.1.) Trade discount details available on application. Press Day June 1958 issue, Wednesday, April 30th. No responsibility accepted for errors.

WARNING

Readers are warned that Government surplus components and valves which may be offered for sale through our displayed or classified columns carry no manufacturers' guarantee: Many of these items will have been designed for special purposes making them unsuitable for civilian use, or may have deteriorated as a result of the conditions under which they have been stored. We cannot undertake to deal with any complaints regarding any such items purchased.

NEW RECEIVERS AND AMPLIFIERS

SHIRLEY LABORATORIES, Ltd., 3, Prospect Place, Worthing, Sussex. Tel. 30536.

THE TWA/1515 stereoscnic tape recording and replay amplifier, separate meter monitoring on record and playback on both channels, 13watts O/P each channel, 96gns. TWA/15 tape recording and reproducing amplifier, 13watts O/P, for Wearite and Collaro decks, 45gns; TW/PA recording and replay pre-amplifier, 30gns; both with valve voltmeter monitoring; type SB/1-15E high-fidelity amplifier exceptionally wide tone-control system, 40mv sensitivity, 20gns; with two inputs and 3-position gram filter, 22gns; specialized amplifiers for the musical and scientific industries ,ncluding the Mullard 20watt. [0095

AM/FM radiogram chassis and feeders, model A/F834, an 8-valve AM/FM R/G chassis; 4 watts output; attractive coloured dial, latest type valves; model A/F73, a 7-valve AM/FM feeder; both models at keen prices; 3d stamp for literature; trade enquiries invited.—Bayly Bros., 46, Pavilion Drive, Leigh-on-Sea, Essex. [7800

RECEIVERS AND AMPLIFIERS—SURPLUS AND SECONDHAND

HRO Rx's and coils in stock, also AR88, BC348R, CR100, etc.—Requirements please to R. T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0053

1143A equipment less valves and crystals, receiver type 71, 3/6 ea., post 3/6; transmitter type 50, 2/6 ea., post 3/6; amplifier type 165, 3/- ea., post 3/-; enquiries and lists, s.a.e. please.—Annakin 25, Ashfield Place, Otley, Yorks. [7772

TV RECEIVERS AND AMPLIFIERS—SURPLUS AND SECONDHAND

MURPHY V1116 chassis, 12in. B.B.C. T.V., tube U.S., sound O.K., complete with facia controls; £8.—507, Croydon Rd., Beckenham. Tel. 2611, evenings. [7769

PHILIPS 17in projection televisions available, as taken in part exchange, complete, but not guaranteed; £9/15, originally £92-£120 each.—Tomlins, 127, Brockley Rise, Forest Hill, S.E.23. [0343

TELEVISIONS needing attention, 9in-10in, nearly all makes, 45/- each, carriage paid; 12in televisions, needing attention, £5 10; 15in, £9/10; write for list.—Tomlins, 127, Brockley Rise, Forest Hill, S.E.23. [0344

DYNAMOS, MOTORS, ETC.—SURPLUS AND SECOND-HAND

9KVA ex-W.D. alternators, B.T.H., 230 volts, single phase.—Box No. 4798. [7771

ROTARY converter, 220/240 v. DC output 230 v., 150 watts at 50 cycles; recently rewound and overhauled by makers; £11 o.n.o. —Thompson, 21, Wellwood Rd., Goodmayes, Essex. [7804

DYNAMOS, MOTORS, ETC., WANTED

WANTED, aircraft type generators, 29 volts 3000 watts and 24 volts 500 watts, required in large quantities at keen prices.—Box No. 4848. [7777

TEST EQUIPMENT—SURPLUS AND SECONDHAND

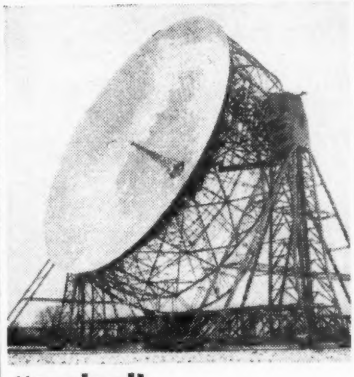
MURPHY pattern generator type II, £35; Avo signal generator, £5; Avo valve tester, £7/10; or £45 the lot.—Comben, Ltd., 128, Fortuneswell, Portland, Dorset.

SIGNAL generators, oscilloscopes, output meters, valve voltmeters, frequency meters, multi-range meters in stock; your enquiries are invited.—Requirements to R. T. & I. Service, 254, Grove Green Rd., London, E.11. Ley 4986

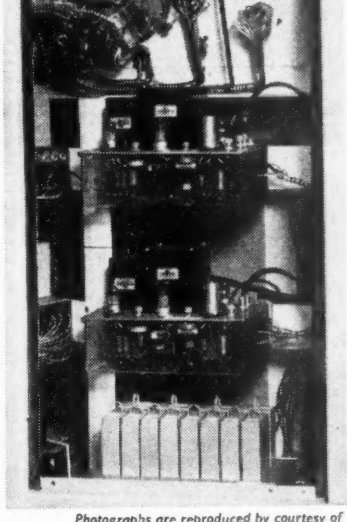
NEW COMPONENTS

A BRAND new list for May that will make your eyes pop! Free and post free to dealers; send your bill head; trade and export only supplied.—A.W.F., 10, Sackville St., Bradford, 1. [0132

CRYSTAL microphone inserts with exceptionally high output (Cosmocord Mic. 6), guaranteed newly made and boxed, 15/6 post free.—Radio-Aids, Ltd., 29, Market St., Watford, Herts. [0170



"seeing" stars with PARTRIDGE



Photographs are reproduced by courtesy of Messrs. Dunford & Elliott (Sheffield) Ltd., suppliers of the electronic equipment.

At top is shown an overall view of the telescope.
Below is a section of the interior of the control equipment.

This Radio Telescope situated at Jodrell Bank and the first of its kind, attracted world fame in tracking the "earth satellites." For work of this nature reliability in operation and in the results achieved are of paramount importance. That is why Partridge Transformers were specified and many hundreds employed in the equipment.

PARTRIDGE TRANSFORMERS LTD.

Roebuck Rd., Chessington, Surrey.

Phone: ELMbridge 6737-8.

COMPONENTS—SURPLUS AND SECONDHAND

AMAZING offer by Waltons of Wolverhampton.
12 DIFFERENT relays of U.S.A. and English manufacture for 37/6 and 2/6 post and packing; large purchase enables us to make this unique offer! Each parcel of 12 includes some or all of the following types: Post Office, miniature, super sensitive, high speed, light and heavy duty, etc., etc.; we cannot select individual types nor repeat once existing stocks are cleared; send now!
WALTONS WIRELESS STORES, 46-48, Stafford St., Wolverhampton. [0147

VALVES, genuine bargains; send for free list. —Dept. VS, 11, Hyde Way, Hayes, Middx. [7803

SOUTHERN RADIO SUPPLY, Ltd., 11, Little Newport St., London, W.C.2. See our displayed advertisement page 188.

HOW to use ex-Gov. lenses and prisms. Nos. 1 and 2 2/6 ea; vertical enlarger plans for 35mm to 2½sq 3/6 ea; optical condensers and Achromatic lens to suit 35/-; lists, s.a.e.—H. W. English, Rayleigh Rd., Hutton, Essex. [0126

MAGSLIPS at low prices, fully guaranteed. 3 in Resolver No. 5 (AP 10861), 50v. 50c/s, unused each in tin. 35/-, post 2/1; large stocks of these and other types.—P. B. Crawshay, 94, Pixmore Way, Letchworth, Herts. Tel. 1851. [0087

ILLUSTRATED Catalogue No. 13 containing over 450 items of Government surplus and model radio control equipment, 2/2, refunded on purchase of goods, 2/6 overseas sea mail.—Arthur Sallis Radio Control, Ltd., Department W.W., 93, North Rd., Brighton. [0193

NEW GRAMOPHONE AND SOUND EQUIPMENT

DON'T miss the LP tape sale of Sound News —See under tape recording etc. [0194

TAPE recorders, Ferrograph, Vortexion, Brenell, Telefunken, M.S.S., Truvox, and Reflectograph.
TAPE decks, Wearite, Brenell, Truvox, Dulci Harting, Sonomag Adaptatape (Collaro).
AMPLIFIERS and tuners, Leak, Quad, R.C.A., Dulci, Dynatron; microphones, Reslo, Acos, Philips, Labor, etc.
ALL tapes and accessories; audio service dept., and recording studio, hire-purchase facilities available.
LAMBDA RECORD Co., Ltd., 95, Liverpool Rd., Liverpool, 23. Great Crosby 4012. [7749

TANDBERG stereophonic tape recorder now being demonstrated by appointment at Grifhano Studios. (See below.)
FERROGRAPH, Harting and Vortexion tape recorders for sale or hire; may we arrange to demonstrate these superb instruments to you; easy terms available.—"Grifhano" Studios (See below.)
RECORDING studio available for personal recordings on disc or tape, dubbing service, mobile recording unit for all functions, etc.—Write or 'phone: Griffiths Hansen (Recordings), Ltd., 24-25, Foley St., London, W.1. Mus. 2771/6375. [7722

GLASGOW.—Recorders bought, sold, exchanged, cameras, etc., exchanged for recorders or vice versa.—Victor Morris, 406, Argyle St., Glasgow, C.2. [0201

CINE-VOX disc recording mechanisms for L.P. or standard operation from 30gns.-56gns.; also complete tape/disc or direct channels from 50gns.-112gns.
DEMONSTRATIONS can be arranged in London.—For full details write to K.T.S., Ltd., "Coplow," Park Rd., Braunton, N. Devon. Callers by appointment only. [0210

DULCI-HARTING tape unit, complete with pre-amplifier and 2-speed tape deck; facilities include superimposition, electronic record level indicator, etc.; 55gns delivered; table model tape replay units, brand new, by well-known manufacturer, originally 60gns; offered at £30 delivered; can be modified for stereo and/or record erase.—E.M.-Plan, Rainbow St., Crewe. [7801

TAPE recorders for home and industry; Brenell, 53gns; Ferrograph recorders from 79gns; Leevers-Rich from £450 according to specification; Standard and L.P. tapes; high quality mics, "Cadenza" Reslo, etc.; speakers, tuners, etc.; tape/disc and complete recording service.—"Eroica" Sound Recording Services (1949), 31, Peel St., Eccles, Manchester. Eccles 1624. Director: Thurlow Smith, A.R.M.C.M. [0122

TAPE RECORDING, ETC.

RENDEZVOUS RECORDS offer comprehensive 78/LP tape to disc recording facilities. —Leaflet from 19 Blackfriars St., Manchester, 3.

FACTORY fresh, guaranteed 1,800ft LP tape from 37/6, 1,200ft std., from 25/-, post free; orders in strict rotation.—Sound News, 10, Clifford St., W.1. [0199

TAPE to disc recording.—L.P. (30 mins.), 27/6; 78s, 13/6, 48-hour service, s.a.e. leaflet.—Marsh, Little Place, Moss Delph Lane, Aughton, Ormskirk, Lancs. Aug. 3102. [7782

HANNEY

offers

Components for

OSRAM 912 PLUS AMPLIFIER
OSRAM 912 PASSIVE UNIT
OSRAM 912 PRE-AMPLIFIER
OSRAM F.M. PLUS TUNER
MULLARD " TAPE " AMPLIFIERS
MULLARD 510 AMPLIFIER

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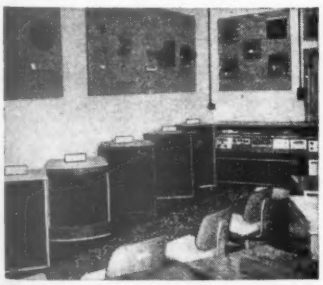

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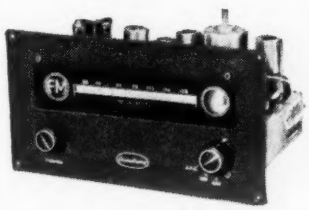

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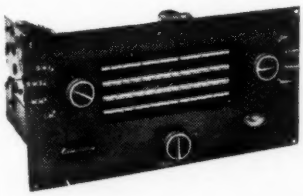
A sensitive high gain VHF Tuner with completely silent background. It covers the full International Band II (88-108 Mc/s) and incorporates switched AFC, Cathode Follower output, adjustable output matching, and Cathode Ray tuning.



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Both these tuners can be used with the Armstrong A10 Amplifier which has adequate power supplies for them. A separate Power Pack (£4.18.0) is however available if required. The front panels of the tuners match that of the A10.

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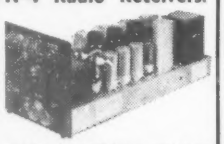

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Components value far exceeds this remarkably low price. Buy now ! Only 150 sets available.

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36ft. HIGH

Kits comprise—9 2in. dia. Tubular Steel (Copper Plated) Sections of 4ft. length, top-section and base, Pickets, Guys and Fittings.

YOU can purchase this normally expensive MAST for a fraction of its cost, i.e.,

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Please add £1 for (returnable) wooden carrying case.

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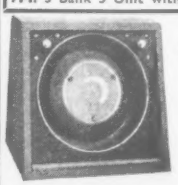

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Impedance 7½Ω Handling cap. 8 watts price 19/6, post 3/6. 40/- pair carr. paid.

Quantity and Export enquiries invited for above items, also other Electronic Component parts.

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PHYSICS (heat) up to hons. standard.
ELECTRONICS and Control Systems A1-A2.
ELECTRICAL Engineering and Science S1-S3.
RADIO and Television Service, inter and final.
APPLICATION forms and details of payment from Secretary at College. (518.) [7799

EXPEDITION TO ANTARCTICA

SCIENTIFIC assistant (Ionospheric) required by the Falkland Islands Dependencies Survey for the operation and maintenance of special electronic Ionospheric recording apparatus at an Antarctic base for two years. Commencing salary according to age in scale £400 rising to £540 a year with all found including food, clothing and canteen stores. Free passages. Liberal leave on full salary. Candidates, preferably single and aged 21-28 years, must be of good education, of high physical standard, and experienced in the servicing of radio or radar equipment. Genuine interest in life at an Antarctic Base essential. Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M3B/44628/WF. [7783

SUNDERLAND Education Committee.

TECHNICAL College.
APPLICATIONS are invited for the post of electronics technician for the repair, maintenance and construction of electronics equipment; applicants should have considerable experience of such equipment, and possess an appropriate qualification, e.g., National Certificate in Applied Thermionics, National Certificate in Applied Physics, City and Guilds Radio or T.V. Servicing Certificate.
SALARY £620×£20 to £660×£25 to £760.
APPLICATION forms, and further particulars, may be obtained from the Registrar, Technical College, Sunderland, Co. Durham, and should be forwarded to the undersigned as soon as possible after the appearance of this advertisement.
CANVASSING will be a disqualification.
W. THOMPSON,
DIRECTOR of Education.
Education Offices,
15, John Street,
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BUCKINGHAMSHIRE EDUCATION COMMITTEE.
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REQUIRED for 1st September, 1958, Laboratory Assistant for Electrical Department. A suitable candidate would require to be of Ordinary National Certificate standard and have had some general experience of light current laboratory work. Duties would include repair and maintenance of experimental equipment and test gear.
SALARY will be paid on the scale £235 to £620 and the starting point will be fixed according to age and previous experience.
APPLICATIONS, together with copies of two recent testimonials, should be forwarded to the Principal at Queen Alexandra Road, High Wycombe, within 14 days of the date of the appearance of this advertisement. [7795

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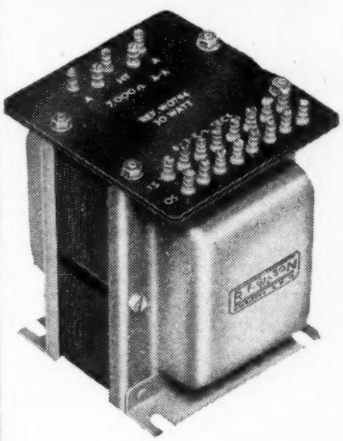

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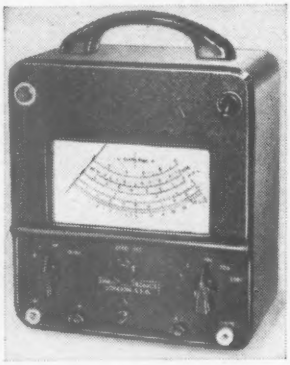

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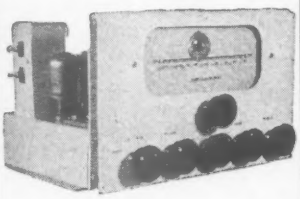

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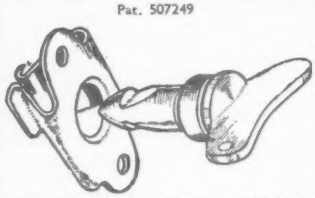

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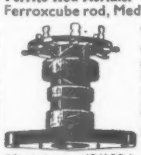

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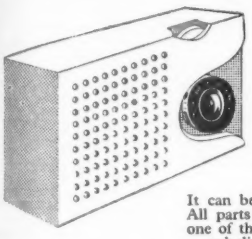

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INDEX TO ADVERTISERS

	Page
A.A. Tools	152
Acoustical Mfg. Co., Ltd.	28
Adcola Products, Ltd.	52
Adler, B., & Sons, Ltd.	162
A.D.S. Relays, Ltd.	166
Advance Components, Ltd.	18
Aircraft Marine Products, Ltd.	49
Alectol, Ltd.	174
Alpha Radio Supply Co., Ltd.	134
Amalgated Wireless (Australasia), Ltd.	74
Amphenol, Ltd.	58
Amplex Appliances (Kent), Ltd.	120
Andec, Ltd.	88
Anders Electronics, Ltd.	64
Antex, Ltd.	90
Antiference, Ltd.	23
Apointments Vacant 172, 175, 176, 177, 178,	179
Arcolectric Switches, Ltd.	86
Ardente Acoustic Laboratories, Ltd.	124
Ariel Pressings, Ltd.	127
Armstrong Wireless & Television Co., Ltd.	54, 183
Aspden, W.	186
Associated Industries Inc.	170
Automat	133
Avinash & Co.	173
Avo, Ltd.	1
Baker's ' Selhurst ' Radio	175
Beamish, V. W.	186
Belling & Lee, Ltd.	101
Benson, W. A.	182
Berry's (Short Wave), Ltd.	62
Bestfrend Electrical Co., Ltd.	174
Birmingham Sound Reproducers, Ltd.	96
Blickvac, Eng., Ltd.	132
Bradmatic, Ltd.	174
Bradmatic Productions, Ltd.	116
Brenell Engineering Co., Ltd.	121
Britain, Chas. (Radio), Ltd. 140,	141
British Institute of Engineering Technology	152, 173
British Insulated Callender's Cables, Ltd.	Cover ii
British National Radio School	156
British Thomson-Houston Co., Ltd.	162
Brookes Crystals, Ltd.	84
Bulgin, A. F., & Co., Ltd.	Edit. 251
Bull, J. & Sons	164
Bullers, Ltd.	95
Candler System Co.	188
Carr Fastener Co., Ltd.	21
Champion Products	173
Channel Electronic Industries, Ltd.	166
Chapman, C. T. (Reproducers), Ltd.	90
City Sale & Exchange, Ltd.	60
Clyne Radio, Ltd. 142,	143
Continental Import Co.	170
Cosmocord, Ltd.	100
Cossor Instruments, Ltd.	106
Cossor Radio & Television, Ltd. 88,	176
Coventry Radio	174
Crane Packing, Ltd.	48
Daly (Condensers), Ltd.	68
Davies, A., & Co.	186
Davis, Jack (Relays), Ltd.	122
Delaney, Gallay, Ltd	73
Denco (Clacton), Ltd.	62
Dependable Radio Supplies, Ltd.	169
Direct T.V. Replacements	172
Dixon, L., & Co.	188
Drayton Regulator & Inst. Co., Ltd.	68
Drivomatic	120
Dubilier Condenser Co. (1925), Ltd.	29
Duke & Co.	159
Dulci Co., Ltd., The	82
Duode Natural Reproducers	184
Eddy's (N'tham), Ltd.	168
E.I.R. Instruments, Ltd.	188
Electro-Acoustic Developments	188
Electro-Acoustic Industries, Ltd.	117
Electro-Methods, Ltd. 13,	37
Electronic Precision Equipment 112,	113
Electronic Technical Services	126
Electronic Tubes, Ltd.	59
Electronics (Fleet Street), Ltd.	161
Electro-Winds, Ltd.	116
E.M.I. College 82,	158
E.M.I. Institutes 102, 107,	133
E.M.I. Sales & Service, Ltd. 85,	110
English Electric Co., Ltd. 61,	178
English Electric Valve Co., Ltd. 47,	178
Enthoven Solders, Ltd.	57
Eta Tool Co. (Leicester), Ltd.	120
Farnell Instruments, Ltd.	75
Ferranti, Ltd. 65,	178
Fibre Form, Ltd.	130
Flanet, W. T.	172
Foyle, W. & G., Ltd.	116
Fringevision, Ltd.	152
Garrard Eng. & Mfg. Co., Ltd., The	124
Gee Bros., Radio, Ltd. 152,	153
General Electric Co., Ltd. 81, 129, 175,	178
Gilfillan, R., & Co., Ltd.	173
Gilson, R. F., Ltd.	185
Gladstone Radio	168
Glaser, L., & Co.	172
Godley's	189
Goldring Manufacturing (G.B.), Ltd.	77
Goodmans Industries, Ltd.	65
Grampian Reproducers, Ltd.	130
Grav & Marten, Ltd.	160
Gray, Arthur, Ltd.	116
Grayshaw Instruments	164
Gresham Transformers, Ltd.	79
Griffiths Hansen (Recordings), Ltd.	172
Grundig (Gt. Britain), Ltd.	87
Hall Electric, Ltd.	44
Hanney, L. F.	182
Harding Electronics	174
Harmsworth, Townley & Co. 170,	173
Harris Electronics (London), Ltd.	155
Harris, H.	170
Harris, P.	182
Hatter & Davis, Ltd. 54,	184
Hawkins, R. B. & Sons	173
Hayward Turbine Eng. Co. (1947), Ltd.	170
Henley's, W. T. Telegraph Works Co., Ltd.	182
Henry's (Radio) Ltd. 150,	151
Hibbert, J. C.	118
Hinchley Engineering Co., Ltd.	16
Hivac, Ltd.	66
Home Radio, Ltd.	189
H.P. Radio Services, Ltd.	86
Hunton, Ltd.	114
Iliffe & Sons Ltd. 41, 94	122
Imhof, Alfred, Ltd.	67
Industrial Electronics	76
Instruments Electrical Co.	174
Jason Motor & Electronic Co 118,	150
Jeffery Transformer Co.	174
Kenroy, Ltd.	172
Keyswitch Co., The	69
Lasky's Radio, Ltd. 138,	139
Leak, H. J., & Co., Ltd.	111
Leevers-Rich Equipment Ltd.	170
Lewis Radio Co. 58,	90
Light Soldering Developments, Ltd.	175
Linear Products, Ltd.	19
Lion Wire, Ltd.	175
Lockwood & Co. (Woodworkers), Ltd.	170
London Central Radio Stores	186
Long Playing Record Library	95
L.R. Supply Co., Ltd.	131
Lyons Radio, Ltd.	166
Magnetic Devices, Ltd.	6
Mail Order Supply Co.	132
Marconi Instruments, Ltd. 55, 177,	179
Marconi's Wireless Telegraph Co., Ltd. 105,	108
Martin, J. H.	172
Mazel Radio Service Station	189
McMurdo Instruments Co., Ltd. 15, 78,	126
Midland Instrument Co.	189
Mills, W.	168
Minnesota Mining & Mfg. Co., Ltd.	56
Modern Acoustics, Ltd.	38
Modern Book Co.	184
Modern Electrics, Ltd.	158
Modern Techniques	156
M. R. Supplies, Ltd.	84
Muirhead, Ltd.	89
Mullard, Ltd. 3, 32, 91, 98,	115
Multicore Solders, Ltd. Cover	iv
Multitone Electric Co., Ltd.	53
Nash & Thompson, Ltd.	14
Newnes, George, Ltd. 32A,	32B
Northern Radio Services	40
Oddie Bradbury & Cull, Ltd.	188
Oryx Electrical Laboratories, Ltd.	60
Osmor Radio Products, Ltd.	170
Oxley Developments Co.	175
Painton & Co., Ltd.	31
Palmer, G. A. Stanley, Ltd.	56
P.A.M., Ltd.	12
Partridge Transformers, Ltd.	181
P.C.A. Radio, Ltd.	128
P.C. Radio	128
Pearce, T. W.	173
Period High Fidelity, Ltd.	4
Phillips & Bonson, Ltd.	30
Pitman, Sir Isaac, & Son, Ltd.	175
Planet Instrument Co.	173
Plessey Co., Ltd., The 27, 39, 43, 104, 176,	179
Post Radio Supplies	172
Premier Radio Co. 92, 93,	94
Preston, A., & Sons	154
Proops Bros., Ltd. 148,	149
Pye, Ltd.	51
Pye Telecommunications, Ltd.	45
Quartz Crystal Co., Ltd.	186
Racal Engineering, Ltd.	42
Radar Electronic Equipment, Ltd.	84
Radio & T.V. Components (Acton), Ltd.	160
Radio Clearance, Ltd.	157
Radio Component Specialists	167
Radio Exchange Co., The	171
Radio Experental Products Co.	172
Radio Ham Shack, Ltd.	166
Radio Resistor, Ltd.	64
Radio Servicing Co.	72
Radiospares, Ltd.	131
Radio Supply Co. (Leeds), Ltd. 144,	145
Radio Telephone Aerial Systems, Ltd.	66
Radio Traders, Ltd.	154
Rank Cintel, Ltd. 5, 35,	177
Relda Radio, Ltd.	165
Rogers Development (Electronics), Ltd.	76
Rola-Celestion, Ltd.	17
Rollet, H., & Co., Ltd.	186
Russell Electronics, Ltd.	83
Salford Electrical Instruments, Ltd.	36
Samsons Surplus Stores	171
Savage Transformers, Ltd	187
Semiconductors, Ltd.	34
Service Trading Co.	163
Servomex Controls, Ltd.	119
Sexton, J. E., Ltd.	150
Siemens & Halske, Ltd.	125
Siemens Edison-Swan, Ltd. 25,	103
Sifam Electrical Instruments, Ltd.	170
Simmonds, L. E., Ltd.	158
Smith, G. W. (Radio), Ltd. 146,	147
Smith, H. L., & Co., Ltd.	185
Société de Propagandre Industrielle & Commerciale	123
Solartron Electronic Group, Ltd.	2
Sonomag, Ltd.	164
Southern Radio Supply, Ltd.	168
Southern Technical Supplies	172
Specialist Switches	120
Spencer-West, Ltd.	174
Stamford A. L.	183
Standard Telephones & Cables, Ltd. 71,	99
Steatite & Porcelain Products, Ltd.	20
Stern Radio, Ltd. 135, 136,	137
Stewart Transformers, Ltd.	160
Stratton & Co., Ltd.	9
Sugden, A. R., & Co (Engineers), Ltd.	70
Sutton Coldfield Electrical Engineers	162
Swan Electronics	186
Tannoy Products, Ltd.	72
Taylor Electrical, Ltd.	70
Technical Ceramics, Ltd.	11
Technical Trading Co.	154
Telegraph Condenser Co., Ltd. Cover	iii
Telegraph Construction & Maintenance, Co. Ltd	50
Telequipment, Ltd.	8
Tele-Radio (1943), Ltd.	187
Teletron Co., The	188
Test Equipment Repair	170
Texas Instruments, Ltd.	80
Thorn Electrical Industries, Ltd.	33
Trix Electrical Co., Ltd. Edit.	249
T.R.S. Radio	156
Truvox, Ltd.	10
Universal Book Co.	174
Universal Electronics	169
Vairadio, Ltd.	88
Venner Electronics, Ltd.	7
Verdik Sales Ltd.	133
V.E.S. Wholesale Services, Ltd.	120
Vitavox, Ltd.	46
Vortexion, Ltd.	109
V.Z Electrical Service	174
Walmore Electronics, Ltd.	86
Walturdaw Cinema Supplies (1952), Ltd.	118
Watts, Cecil E.	152
Wayne Kerr Laboratories, Ltd., The	24
Webber, R. A., Ltd.	150
Webb's Radio, Ltd. 132,	172
Weymouth Radio Mfg. Co., Ltd., The	80
Wharfedale Wireless Works	74
White, S. S., Co., of Great Britain, Ltd., The 52,	90
Whiteley Electrical Radio Co., Ltd.	22
Wilkinson, L. (Croydon), Ltd.	171
Wilson, Ronald, & Co.	174
Wolsey Electronics, Ltd.	131
Wright & Weaire, Ltd.	76
Young, C.	169
Z. & I. Aero Services, Ltd.	180

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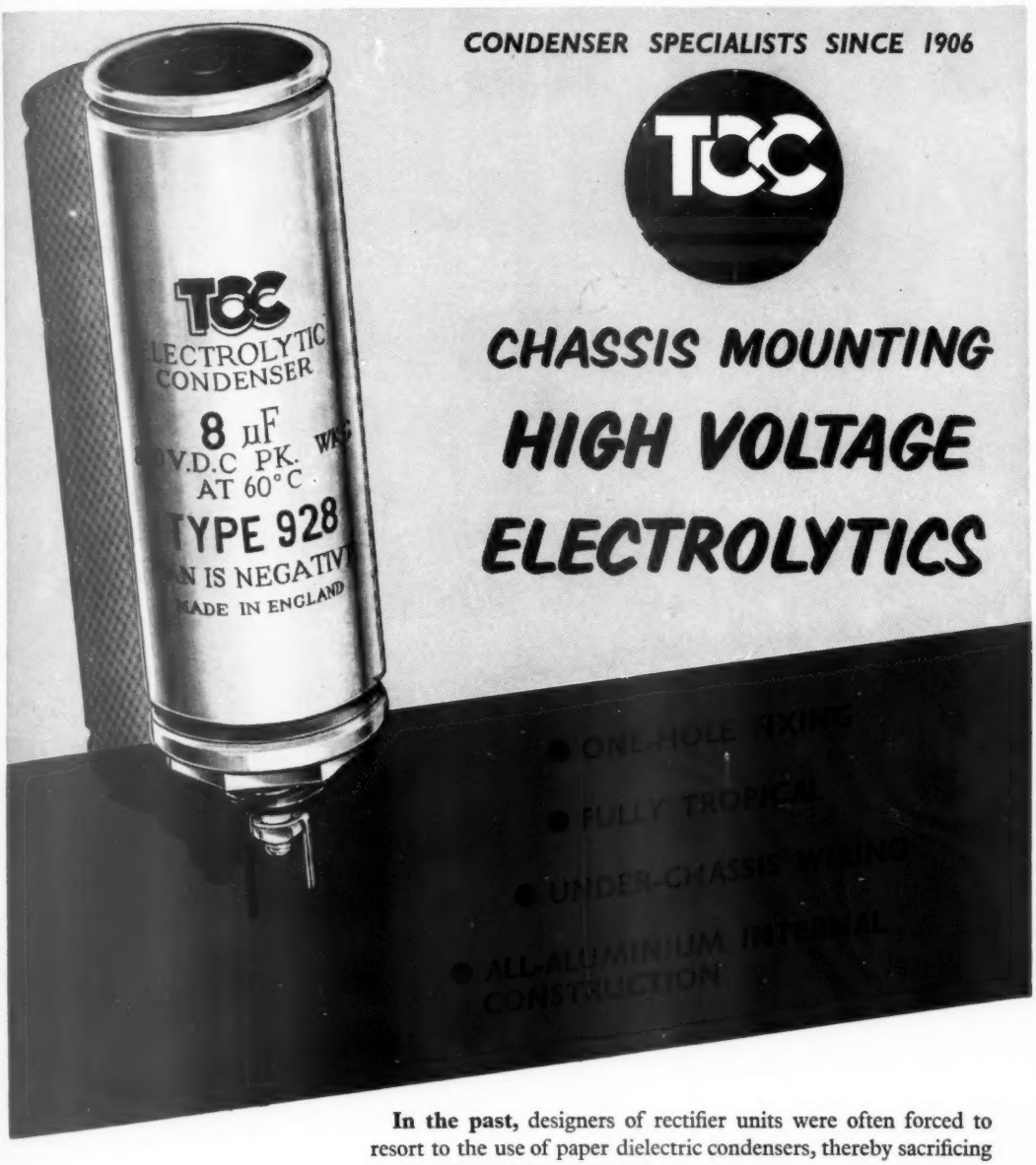


In the past, designers of rectifier units were often forced to resort to the use of paper dielectric condensers, thereby sacrificing space and involving extra cost.

The demand for an electrolytic condenser which would cover such requirements up to 800v. prompted us to introduce **Type 928,** and this has proved a small and most efficient substitute for a large paper condenser.

The ability of this condenser to withstand these higher working voltages is due to the application of new materials and techniques.

RATING :

800v. D.C. Wkg.
900v. surge at 60°C.
or 700v. D.C. Wkg.,
800v. surge at 70°C.

LIST PRICE 15/- each.

THE TELEGRAPH CONDENSER CO. LTD.

Reflectograph

TAPE RECORDERS AND CONTINUOUS PLAYERS FOR INDUSTRY

MODEL 500

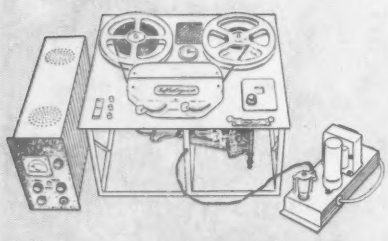
THE REFLECTOGRAPH professional tape recorder previously supplied in limited quantities to Broadcasting authorities, Recording Studios and Laboratories, is now being manufactured by Multimusic Ltd.

The Reflectograph Model 500 is self-contained. The portable duo-tone case is finished in luxan hide and pigskin colours and is complete with an output amplifier and two matched loudspeakers.

Model 501 has the same technical specification but is supplied in a metal case for industrial use.

Reflectograph 400 is supplied in three units for incorporation in laboratory equipment. It comprises the Reflectograph deck mounted on a stand, combined record amplifier and playback pre-amplifier and power pack. The units complete with inter-connecting leads have been designed for operation in conjunction with leading makes of high fidelity amplifiers.

Reflectograph Model 550 has the same technical specification as Model 500 with an additional replay amplifier to provide stereophonic reproduction from tape and from records if a suitable pick-up is connected. The fine wood case does not incorporate the loudspeakers.

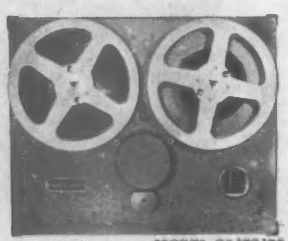


MODEL 400

THE REFLECTOGRAPH IS THE ONLY RECORDER IN THE WORLD POSSESSING ALL THESE FEATURES

- Fitted with 3 heads, separate record and replay amplifiers, enabling instant comparison to be made between signal recorded on tape and the input.
- Variable speed between 8 and 3¾ i.p.s. Stroboscope, lit by neon lamp, shows precise speeds of 7½ and 3¾ i.p.s.
- Easy tape threading into a straight slot. Provision for conversion to stereo. Lever deck controls, providing variable speed wind forward and back from extra fast to inching for editing; sound available for editing if required; instant stop and start.
- Peak level recording meter; Push-button record-playback controls with record safety latch; Clock-type tape position indicator; 3 Garrard motors; 2 matched loudspeakers; Accommodates up to 8¼" reels.
- 3 watts undistorted output; overall response strictly to C.C.I.R. recommended specifications; 2 input and 2 output sockets. Fitted with Bib tape splicer on deck, complete with reel of tape, spare reel, 2 screened jack plugs.

Model 400 specification is similar to above, excluding 3 watts output, 2 loudspeakers and 1 output socket. Additional facilities include sockets on chassis for radio and pick-up; socket for microphone on instrument panel, where an additional switch provides instant selection of 3 inputs.



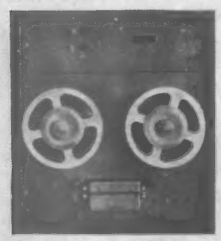
MODEL 81/70/75

CONTINUOUS TAPE REPRODUCERS FOR BACKGROUND MUSIC AND AUTOMATION

TheReflectograph Continuous Players are probably the first British Made heavy duty machines in quantity production, specially designed to play recorded tapes continuously. Tapes are easily threaded and the machine may be started and stopped manually, remotely or by a clock. The tape is played down one track, automatically reverses and continues to play on alternate tracks until switched off.

Model 81/70/75 operates at 3¾ i.p.s. and plays for up to 2 hrs. 8 mins. on each of two tracks. By means of a 20 cycle note, recorded at the end of each track, the machine automatically reverses. A 3 watt amplifier is incorporated but a high level output is available. Start and stop is electrically controlled so that remote or clock operation is available.

An alternative model incorporating a recording head and amplifier is available with a selective amplifier for the recording and reproduction of tones for instrumentation and automation.



MODEL 90 SERIES

Model 90 series, made to special order, provides all the above facilities with reversing by note or light with capacity of up to 12 hours playing time before repeating. These machines are of the standard size for rack mounting and can be supplied to operate at other speeds than 3¾ i.p.s.

For full information please write to:

REFLECTOGRAPH DIVISION, MULTIMUSIC LTD.,
MAYLANDS AVENUE, HEMEL HEMPSTEAD, HERTS.

MAY, 1958

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